

CORSAIR ONE PRO
The coolest pre-built
system ever **PG. 82**



AMD RYZEN 5 1600X
Multithreaded monster
hits the mainstream **PG. 80**



PLAY ON THE MOVE
Get up and running
with Remotr **PG. 68**



MAXIMUM **PC**

MINIMUM BS • JUNE 2017 • www.maximumpc.com

BEST RYZEN BOARDS

NO.1
FOR PC
HARDWARE

Pick the perfect mobo
for your new AMD build

- ✓ Best value & features
- ✓ Top performers
- ✓ B350 vs. X370

**WINDOWS 10
UPGRADED!**



What the Windows 10 Creators
Update means for your rig **PG. 40**

Future





VENGEANCE[®] RGB

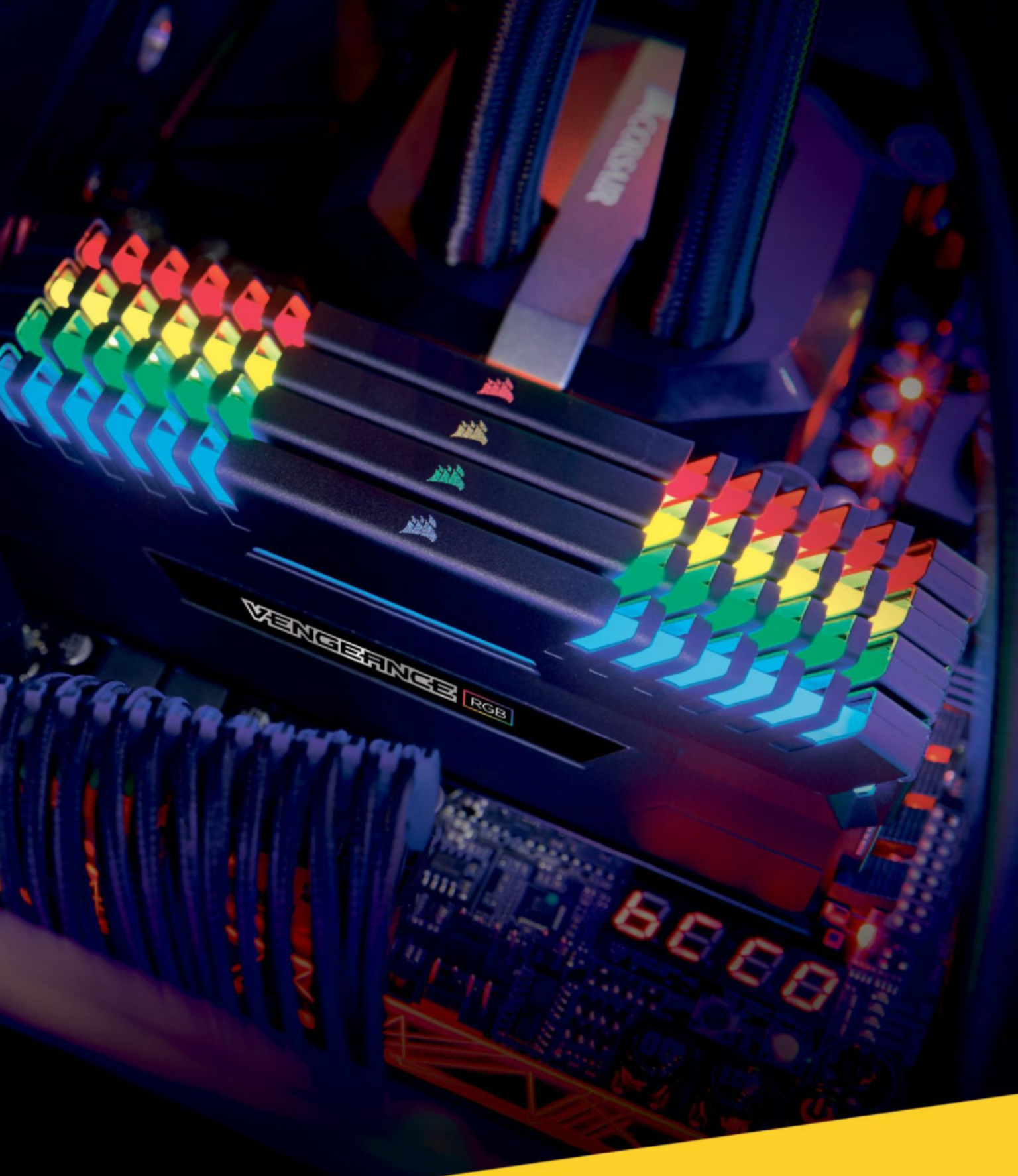
STUNNING RGB. STRIKING SPEED

CORSAIR VENGEANCE RGB series DDR4 memory lights up your system like never before, with vibrant wire-free, customizable RGB lighting, all controlled via CORSAIR LINK software. Synchronize lighting across up to eight modules with a host of RGB effects and overclock with ease thanks to XMP 2.0 profiles, an integrated heatspreader and specially selected ICs for maximum performance.

Learn more at corsair.com/vengeanceRGB



**BUILD IT
BETTER**



Also Compatible with Gigabyte RGB Fusion and MSI Mystic Light Sync



Windows

iBUYPOWER Recommends Windows



D859

\$1999.00

Windows 10 Home
Intel® Core™ i7-6800K Processor
ASUS X99-E Motherboard
NVIDIA® GeForce® GTX 1080 8GB
16GB DDR4-2400 Memory
256GB SSD + 1TB 7200RPM HDD
iBUYPOWER Noctis Blue Case
Asetek 550LC Liquid Cooling
Wireless AC Compatibility



Z840

\$1199.00

Windows 10 Home
Intel® Core™ i7 6700K Processor
MSI Z270 Motherboard
NVIDIA® GeForce® GTX 1060 3GB
8GB DDR4-2400 Memory
240GB SSD + 1TB SATA-III HDD
24X DVDRW
Chimera 5 Flame Case
Asetek 550LC Liquid Cooling
Wireless AC Compatibility



Z807

\$899.00

Windows 10 Home
Intel® Core™ i5-6400 Processor
MSI Z270 Motherboard
NVIDIA® GeForce® GTX 1050ti 4GB
8GB DDR4-2400 Memory
1TB SATA-III HDD
24X DVDRW
Chimera Snow Case
Asetek 550LC Liquid Cooling
Wireless AC Compatibility

Work easy. Play hard.  Windows

**FREE LIQUID COOLING
ON ALL DESKTOPS**





Play great new Xbox games on Windows 10 with the stunning performance of DirectX 12.*

Play great new Xbox games on Windows 10 with the stunning performance of DirectX 12.* Stay connected to your gaming community with the Xbox app. And play where you want with in-home streaming.**

*Games, accessories, and media content sold separately. Limited number of games available in 2016 support cross-device play; additional games to follow. DirectX 12 only available with supported games and graphics chips. Check PC to determine graphics chip compatibility.

** Streaming functionality available in supported games; stream to one device at a time; streaming with multiplayer from Xbox One requires home network connection and Xbox Live Gold membership (sold separately). Xbox One Backward Compatibility feature works with select Xbox 360 games, see <http://www.xbox.com/backcompat>. Xbox Live and broadband internet required for initial download of game to console.

IBP Z530

\$1,499.00

Windows 10 Home
Intel Core i7-7700HQ Processor
NVIDIA GeForce® GTX 1060 3GB
MSI GE72VR Apache Pro
17.3" Full HD Anti-Glare 120Hz
16GB DDR4-2400 Memory
256GB M.2 SATA SSD + 1TB HDD
DVDRW
Wireless AC + Bluetooth 4.0



IBP A320

\$1,099.00

Windows 10 Home
Intel Core i7-7700HQ Processor
NVIDIA GeForce® GTX 1050 4GB
ASUS GL553VD-DS71
15.6" Full HD Display
16GB DDR4-2400 Memory
1TB HDD
DVDRW
Wireless AC + Bluetooth 4.0

IBP Z730

\$1,849.00

Windows 10 Home
Intel Core i7-7700HQ Processor
NVIDIA GeForce® GTX 1070 8GB
MSI GT72VR Dominator Pro
17.3" Full HD Anti-Glare 120Hz
16GB DDR4-2400 Memory
256GB M.2 SATA SSD + 1TB HDD
DVDRW
Wireless AC + Bluetooth 4.1



IBUYPOWER

Order today

ibuypower.com

888-462-3899



ALL Systems are Assembled in the USA.

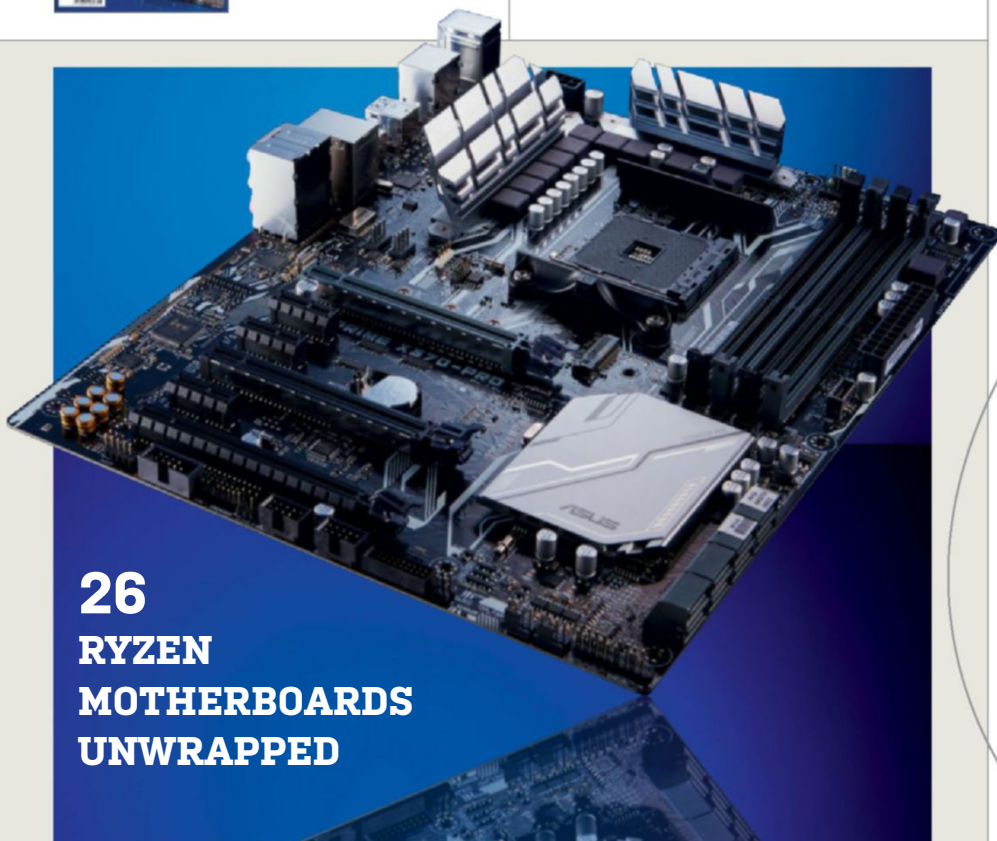


All IBUYPOWER Systems Come with a FREE 3 Year Warranty & Lifetime Tech Support



inside

JUNE 2017



26 RYZEN MOTHERBOARDS UNWRAPPED

26 RYZEN MOTHERBOARDS UNWRAPPED

We take a look at the very best Ryzen has to offer, and discover which is the best mobo for your new AMD build

40 WINDOWS 10 CREATORS UPDATE EXPLAINED

The second major update to Windows 10 has just dropped. Here's all you need to know about the changes it brings to your OS

50 DUAL-BOOT ELEMENTARY & WINDOWS

Set up this slick Linux OS alongside Windows, and benefit from the best of both worlds

QUICKSTART

12 THE NEWS

Intel's X-Series pushed forward; Apple car; Android is top dog.

18 THE LIST

Maximum PC's selection of Intel's biggest cancellations.



A project that required cross-brand co-operation, plus the chance to push a GTX 1080 Ti to its limit

R&D

58 AUTOPSY

We get touchy-feely with the guts of a MacBook Pro 15" Touch Bar.

60 HOW TO

Run a neural network on your Pi; become a metadata master; play PC games on your smartphone.

72 BUILD IT

Find out how we built a gorgeous gaming rig for our PC Gamer pals.

LETTERS

22 DOCTOR

94 COMMENTS

IN THE LAB



78 SAPPHIRE RADEON RX 580 NITRO+



82 CORSAIR ONE PRO



86 COOLER MASTER MASTERPULSE

90 MASS EFFECT EFFECT ANDROMEDA





CyberPowerPC recommends Windows.
One experience for everything in your life.



FREE LIQUID COOLING

CPUs with standard fansinks can reach core temperatures as high as 130°C, however, liquid cooling can lower that to 59°C giving you better performance and longer lifespan on your CPU.

\$54.99
VALUE



Unlock the world's first 8-core desktop CPU.
Oh wait, we already did.
Get 8-Cores in your system.

Gamer Master 8000



Windows 10 Home

AMD Ryzen 7 1700 Processor

AMD X370 Mainboard
8GB DDR4 Dual Ch. Memory
120GB SSD + 2TB SATA III DATA HDD
AMD Radeon™ RX 570 4GB DirectX 12
Cyberpower Aula Gaming Headset
NZXT Source 340 Orange with tempered glass
Corsair® H60 Liquid Cooling System



FROM
\$1059



HD 7.1



Cyberpower



Cyberpower

Gamer Master 9000



Windows 10 Home

AMD Ryzen 7 1700X Processor

AMD X370 Mainboard
16GB DDR4 Dual Ch. Memory
240GB SSD + 3TB SATA III DATA HDD
AMD Radeon™ RX 580 8GB DirectX 12
Cyberpower Aula Gaming Headset
Thermaltake Core P3 + 600W 80+ PSU
Corsair® H60 Liquid Cooling System



FROM
\$1445



HD 7.1



Cyberpower



Cyberpower

Gamer Master 7500



Windows 10 Home

AMD Ryzen 5 1600X Processor

AMD X370 Mainboard
8GB DDR4 Dual Ch. Memory
2TB SATA III HDD 7200RPM Cache
AMD Radeon™ R7 560 2GB Video
Cyberpower Aula Gaming Headset
CoolerMaster Masterbox 5T + 350W PSU



FROM
\$885



HD 7.1



Cyberpower



Cyberpower

Gamer Dragon



Windows 10 Home

AMD Ryzen 5 1400 Processor

AMD X370 Mainboard
8GB DDR4 Dual Ch. Memory
Western Digital Blue 1TB SATA III HDD 7200RPM
AMD Radeon™ RX 550 2GB DirectX 12
Raidmax Viper II + 600W 80+ PSU
Cyberpower Aula Gaming Headset
Asetek Liquid Cooling System



FROM
\$799



HD 7.1



Cyberpower



Cyberpower

730 Baldwin Park Blvd., City of Industry, CA 91746

All Desktop systems come with 3 year Limited Warranty + lifetime toll free techsupport
CyberPowerPC, CyberPowerPC Logo and, Unleash The Power are trademarks of CyberPower Inc. Copyright © 2013
CyberPower. All rights reserved. All prices are subject to change without notice or obligation. AMD, the AMD Arrow
logo, AMD Phenom™ II, AMD Phenom™, ATI Radeon™ Graphics, 790 Series, and combinations thereof are
trademarks of Advanced Micro Devices, Inc. NVIDIA®, nForce®, GeForce®, SLI™ are trademarks or registered
trademarks of NVIDIA Corporation or its subsidiaries in the United States and other countries.
Cortana available in select markets at launch, experience may vary by device.

*External monitor must support HDMI input (if continuum-compatible accessory is not included, add: "Accessories
sold separately.") **App availability and experience varies by device and market. Office 365 subscription required
for some features. †Limited to select premium phones at launch. Feature and app availability and experience may
vary by market and device. Windows Hello required specialized hardware, including fingerprint reader, illuminated
IR sensor or other biometric sensors.



CYBERPOWERPC
UNLEASH THE POWER

ORDER TODAY! **800.707.0393**
www.cyberpowerpc.com

Work easy. Play hard.



Windows

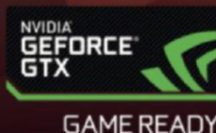
EON15-S = The Best Laptop for Work and Play

STARTING
AT
\$999



New EON15-S

- ✓ WORK FASTER = NVIDIA GEFORCE **GTX 1050 TI**
- ✓ PAY LESS = STARTING AT **\$999**
- ✓ PLAY MORE = UP TO **6 HOURS** OF BATTERY LIFE



FREE Lifetime 24/7 Service & Support
Online Financing Available

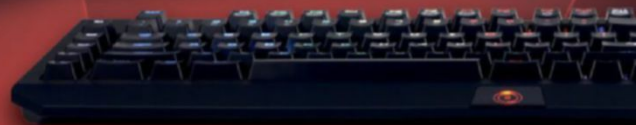
© 2017 ORIGIN PC Corporation. All rights reserved. ORIGIN "O" Symbols are trademarks of ORIGIN PC Corporation. All other trademarks are property of their respective owners.

Back to School Specials Now Available at ORIGINPC.com

OMNI All-in-One



CHRONOS



ORIGINPC.COM

@originpc



©2017 Electronic Arts Inc. EA, the EA logo, Mass Effect: Andromeda, BioWare and the BioWare logo are trademarks of Electronic Arts Inc.



RYZEN

RYZEN 7 PRO

\$2099.00

Windows 10 Home
AMD R7 1800X Processor
16GB DDR4-2400 Memory
Nvidia GTX 1080Ti 8GB
240GB SSD
1TB SATA-III Hard Drive
ASROCK X370 KILLER SLI
NZXT Noctis Red Case
FREE KEYBOARD, MOUSE,
GAMDIAS HEADSET

RYZEN 5 GAMER

\$1099.00

Windows 10 Home
AMD R5 1500X Processor
8GB DDR4-2400 Memory
Nvidia GTX 1060 3GB
1TB SATA-III Hard Drive
ASROCK X370 KILLER SLI
Chimera 5 Flame Case
FREE KEYBOARD, MOUSE,
GAMDIAS HEADSET



The best Windows ever for gaming.

Gaming just got even better with Windows 10. Not only do your existing PC games work great, but now you can also play great new Xbox titles on your PC, including Gears of War 4 and Halo Wars 2.

**Games and media content sold separately. Gears of War 4 coming Fall 2016; Halo Wars 2 coming late 2016. PC hardware requirements may vary for games on Windows 10.*

iBUYPOWER Recommends Windows

Work easy. Play hard. Windows

Available at:
ibuypower.com



All iBUYPOWER Systems Come with a FREE
1 Year Warranty & Lifetime Tech Support



ALL Systems are Assembled in the USA.

All content and prices are subject to change without notice or obligation.

MAXIMUMPC

EDITORIAL

Editor-in-Chief: Tuan Nguyen
Executive Editor: Alan Dexter
Senior Editor: Jarred Walton
Reviews Editor: Zak Storey
Technology Editor: Bo Moore
Contributing Editor: Chris Angelini
Contributing Writers: Alex Campbell, Alex Cox, Cat Ellis, Ian Evenden, Matthew Hanson, Jeremy Laird, Chris Lloyd, Nick Peers, Mayank Sharma
Copy Editor: Katharine Davies
Editor Emeritus: Andrew Sanchez

ART

Art Editor: Fraser McDermott
Image Manipulation: Gary Stuckey
Photography: Future Photo Studio

BUSINESS

Vice President, Sales: Stacy Gaines, stacy.gaines@futurenet.com
Vice President, Strategic Partnerships: Isaac Ugay, isaac.ugay@futurenet.com
East Coast Account Director: Brandie Rushing, brandie.rushing@futurenet.com
East Coast Account Director: Michael Plump, michael.plump@futurenet.com
West Coast Account Director: Austin Park, austin.park@futurenet.com
West Coast Account Director: Brandon Wong, brandon.wong@futurenet.com
West Coast Account Director: Tad Perez, tad.perez@futurenet.com
Director of Marketing: Robbie Montinola
Director, Client Services: Tracy Lam
Director, Retail Sales: Bill Shewey

PRODUCTION

Head of Production UK & US: Mark Constance
Production Controller: Vivienne Calvert
Project Manager: Clare Scott
Production Assistant: Emily Wood

FUTURE US, INC.

One Lombard Street, Suite 200, San Francisco, CA 94111
 Tel: (650) 872-1642, www.futureus.com

Global Chief Revenue Officer: Charlie Speight
Vice President, Marketing & Operations: Rhoda Bueno
Finance Director: Ryan Lamvik
HR Generalist: Carla Marcos

SUBSCRIBER CUSTOMER SERVICE

Maximum PC Customer Care,
 Future Publishing, PO Box 2024, Langhorne, PA 19047
 Website: <http://myfavoritemagazines.com>
 Tel: +44 344 848 2852
 Email: contact@myfavouritemagazines.com

BACK ISSUES

Website: <http://myfavoritemagazines.com>
 Tel: +44 344 848 2852

REPRINTS

Future US, Inc., 4000 Shoreline Court, Suite 400,
 South San Francisco, CA 94080
 Website: www.futureus.com
 Tel: 650-872-1642, Fax 650-872-2207

Next Issue on Sale June 27, 2017



Future is an award-winning international media group and leading digital business. We reach more than 57 million international consumers a month and create world-class content and advertising solutions for passionate consumers online, on tablet and smartphone, and in print.

Future plc is a public company quoted on the London Stock Exchange (symbol: FUTR).
www.futureplc.com
Chief executive Zillah Byng-Thorne
Non-executive chairman Peter Allen
Chief financial officer Penny Ladkin-Brand
Managing director, Magazines Joe McEvoy
 Tel +44 (0)1225 442 244

©2017 Future US, Inc. All rights reserved. No part of this magazine may be used or reproduced without the written permission of Future US, Inc. (owner). All information provided is, as far as Future (owner) is aware, based on information correct at the time of press. Readers are advised to contact manufacturers and retailers directly with regard to products/services referred to in this magazine. We welcome reader submissions, but cannot promise that they will be published or returned to you. By submitting materials to us, you agree to give Future the royalty-free, perpetual, non-exclusive right to publish and reuse your submission in any form, in any and all media, and to use your name and other information in connection with the submission.



Tuan
Nguyen

MY LOVE-HATE RELATIONSHIP WITH WINDOWS

WINDOWS IS, NO DOUBT, a very large part of my life. It's involved with me at a personal level and is part of my career. For work, I use Windows every day—from benchmarking to testing out new hardware to playing games, everything is done on Windows. It goes without saying that Windows is deeply embedded into nearly every facet of my reality.

The relationship has been long—27 years, in fact, since Windows 3.0. Both of us have evolved over time. Like any serious relationship, we've had our ups and our downs, but at the end of the day, it's been there for me.

Windows does have its quirks, though. Sometimes, in the middle of a long conversation, it just ups and leaves. Sure, it returns after a minute or two, but I would appreciate some sort of heads-up. You know, like saying, "Hey, I need a quick break, I'll be right back." But no, it just throws a fit, and when it does return, it's to a clean slate—it's forgotten everything we were talking about.

There have been years when our relationship was really on the rocks—the Vistas of our old place weren't nearly as nice as they were supposed to be. But, thankfully, Windows has learned from some of its more grievous mistakes. For the most part, I've been content. More recently, it got a major makeover, coming to me with new ideas.

For one, it now tells me it's more eager to play games, and even tries to stop doing other tasks to make sure it stays focused. It brought home some new colored outfits, and is even more aware of how important security is to me. At night, Windows is more thoughtful,

too, dimming the lights to a warmer tone to help my eyes and let me sleep better.

But for all of its efforts, I have to admit, my eyes are starting to wander. I catch myself looking at others, admiring their sexy cat-print outfits. I've never been promiscuous, but there are things about Windows that have really grown stale.

In recent times, I've been going out more often, and Windows doesn't like the outdoors. My phone follows me everywhere, and has introduced me to many more places around the city than Windows ever did—recently I've been mountain hiking a lot. When I look at my watch, it knows how I feel. It can tell if I'm staying healthy, and lets me know that I'm doing better at my goals.

To be honest, I've been seeing another on the side. It's awful to admit, but I find this new relationship so much more fulfilling. I don't want to reveal any identities, so let's just refer to it as the cloud. What I can say is that most things Windows was good at, the cloud is better. It stays with me. I can go from one PC to another—even a Mac—and stay synched.

Thankfully, the game life with Windows is still great. It always shows me new ideas to keep things spicy. And now that I've got VR-gra, our gaming sessions last even longer.

Tuan Nguyen is Maximum PC's editor-in-chief, also known as "the pointy end of the stick." He's been writing, marketing, and raising hell in the tech industry for 20 years.

submit your questions to: comments@maximumpc.com

THE NEWS

Intel's X-Series Pushed Forward

Intel shifts release schedule to counter Ryzen

THE BUZZ around AMD's Ryzen has been frantic, and the x86 HEDT (High-End Desktop) world has become refreshingly competitive. Intel's initial response was some fairly enthusiastic price cuts, but now the company has something more solid, because it has pushed forward the launch of its "Basin Falls" X-series platform to this year's Computex show, all ready for sale in June, two months early.

The Basin Falls platform consists of the X299 motherboard chipset, new R4 LGA2066 socket, and X-Series processors. At launch, we will see four new chips: one Kaby Lake-X and three Skylake-X. The newer Kaby Lake chip has a better optimized architecture, but the Skylake has the grunt. Other goodies include up to 10 USB 3.0 ports, plus eight SATA Gen3 ones.

The six-core Skylake-X will support 28 PCIe lanes, while the eight- and ten-core versions will get 44 lanes. All get support for four-channel memory. The first Kaby Lake-X has a more modest four cores, 16 PCIe lanes, and dual-channel memory. Both families are 14nm pieces, and will be branded as i7-7000 series. It's that 10-core Sky Lake-X that will draw the most attention, as Intel fights for the bragging right

as top dog. A 12-core Skylake-X isn't far behind, either—August looks likely.

We were expecting something pretty solid from Intel; it's not a company that takes its position lightly, and the renewed competition from AMD looks to have focused a few minds. The whole of Intel's release schedule has been given a good shake-up. Coffee Lake is also expected to make an early appearance this summer, rather than early next year. This is still a 14nm chip based around the Kaby Lake core, but is about 15 percent more efficient and, more importantly, will have up to six cores. We'll get a new 300-series platform,

too. The X-series may grab headlines for a while, extreme editions always do, but Coffee Lake is as significant a launch. The jump after that is to the 10nm Cannon Lake, a shrink and optimization of Kaby Lake, which is due next year. Intel has just invested \$100 million in five new EUV machines, used in extreme ultraviolet lithography, to boost development.

We were expecting the X-Series to arrive in August and be shown off at the Intel Developer's Forum. Unfortunately, the IDF has been canned, which is a pity, because it was always a great event for talking directly to engineers, and has become something of

an institution—it's been held every year since 1997. Intel says it has extensive online documentation to answer any technical questions, but that's not the same as buttonholing an engineer over coffee. At least the company won't have to suffer any more embarrassing demonstration failures in front of an invited audience.

Meanwhile, AMD has plenty more to bring us. It has a 16-core version of its Ryzen and the accompanying X399 platform in the pipeline for this fall, aimed squarely at the highest of the high end. Good news all around—there's nothing like some real competition to move things along. **—CL**



Intel doesn't take its position lightly, and the competition has focused a few minds.



Unbeatable ENERMAX Innovations



Highest Wattage SFX Power Supply in 100mm Depth

REVOLUTION SFX II



Innovative Dual-fan Power Supply Creates Active Ventilation

DUOFlow™ Design + FMA Technology REVOLUTION DUO



APPLE'S CAR PROJECT BACK ONLINE

TRY HIDING RESEARCH ON THAT SCALE

SELF-DRIVING CARS are big. From Google to Uber, Tesla, and beyond, the tech is exploding. Apple has been toying with the idea for some time, under the name Project Titan. It went quiet for a while, and Apple claimed to be only interested in the in-car technology and software. However, it has been busy hiring automotive experts, moving executives about, and has just

been granted a permit to test self-drive cars in California.

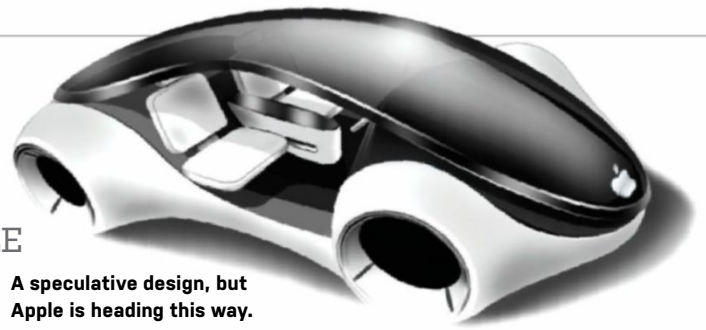
Whether or not we see a fully Apple-branded car is another matter, although the success of Tesla must make it tempting. Despite modest sales, Tesla's share price makes it the world's most valuable car company, bigger than Ford or General Motors. This wealth isn't built on hard profits—the company

A speculative design, but Apple is heading this way.

doesn't make any—but it shows confidence from the markets that it's on the right track. Tesla has been dubbed the Apple of the car world—annoying if you're actually Apple.

Apple has a record of taking a market and really shaking it up, from phones to music

players, to simple laptops. Taking on the car market is a tall order, but Tesla shows that you can certainly take on the aspirational high end of it. Don't hold your breath, though; it'll be 2020 at the earliest before we see anything you can drive, or be driven in. **—CL**



NES CLASSIC KILLED

But we will get a SNES Classic instead

IT SEEMS WE DO LOVE a bit of retro gaming. Nintendo re-launched its NES console last year, and the shrunken Classic edition cost just \$60 and shifted 1.5 million units, proving something of a cult hit. Demand was such that it had to arrange extra shipments, and a vibrant secondary market developed. However, Nintendo has stopped making it, along with the controller, too. According to a company statement, it "wasn't intended to be an ongoing long-term product." It seems its success took Nintendo by surprise; the console was only supposed to be a limited holiday season special.

The good news is it means manufacturing capacity has been released for this year's slice of retro, a SNES, again a shrunken mini version. The SNES has a massive range of classic games, including examples from the *Final Fantasy*, *Legend of Zelda*, *Street Fighter*, and *Super Mario* franchises. Again, this will be a limited run machine, and Nintendo won't want any left over—so, as they say, order early to avoid disappointment. Question is, will we get a mini N64 next year? **—CL**

ANDROID NOW TOP DOG

It's the most used OS in the world

WINDOWS IS NO LONGER the most popular OS used to access the Internet. According to StatCounter, Android accounts for 37.93 percent of devices, against 37.91 percent for Windows. It highlights the massive move from desktop to pocket. In 2012, Android had just 2.4 percent.

Where are Windows phones? At 1 percent. Microsoft still dominates the desktop, but never effectively managed the move into mobile devices. Apple's iPhone showed the world how to do it, and Android did it for the mass market. Meanwhile, Windows on phones was viewed as an embarrassing dad trying to dance with the youngsters at a party. Not cool. It can't buy its way out of trouble, either; it might have been possible in 2005, but Google bought Android instead, and now it's open source. This is one tech bus that Microsoft has missed. **—CL**



Tech Triumphs and Tragedies

A monthly snapshot of what's good and bad in tech

TRIUMPHS

STARCRAFT FOR FREE

Blizzard has released an updated free version of its 1998 *Starcraft*, it's Win 10 friendly, bug-fixed, and has a new OpenGL backend.

EDIBLE WATER

A biodegradable water pouch with an edible membrane has been developed to curb plastic waste.

DDR TO LIVE ON

JEDEC has started laying out the specifications for DDR5 memory, expected to have double the capacity and speed of DDR4.

TRAGEDIES

SEEING RED

There's a lot riding on Samsung's new Galaxy 8, and already it has problems—many have shipped with faulty red-tinted screens.

APPLE DROPS CHIPMAKER

After Apple announced it is to stop using its chips, Imagination Technologies' shares have crashed by 70 percent.

CRASH STOPS UBER

Uber's suspended its self-driving car tests after an accident in Arizona left a car on its side.



Jarred Walton

TECH TALK

Will the Real Titan Xp Please Step Forward?

WHEN NVIDIA RELEASED the Pascal version of the Titan X last August, it created an overlap on the Titan X name. That caused confusion, so instead of calling the new card the Titan X (Pascal), the unofficial name became Titan XP.

Now we know why Nvidia didn't use that name in the first place, because following the launch of the GTX 1080 Ti, which boasts slightly higher performance than the Titan X (Pascal), we have the new Titan Xp. And unlike all the earlier cards, the Titan Xp comes with a fully armed and operational GP102 GPU.

As for specs, the Titan Xp isn't just a full GP102 processor with 3,840 CUDA cores. It has 12GB of GDDR5X memory, and the memory runs at an impressive 11.4Gb/s. The GPU clock is also higher than the Titan X, matching the 1080 Ti. Combined with the extra 1GB of memory and an extra 32 bits on the memory interface, the Titan Xp has 13 percent more total memory bandwidth and 7 percent more computational power than the 1080 Ti. It also retains the \$1,200 price point of the Titan X (Pascal).

I suspected something like this would happen ever since the Titan X (Pascal) first launched, because it had two SM clusters disabled. This is in clear contrast to the Titan X (Maxwell), which has a fully enabled GM200 GPU, looking more like the Titan (Kepler), with its partially disabled GK110 core. Nvidia left room for the Xp by releasing the GTX 1080 Ti with 11GB of memory and a 352-bit bus, still with a partially disabled GP102 chip. We end up, then, with a repeat of the 780, Titan, 780 Ti, Titan Black rollout of the Kepler days—without the added bonus of fast FP64 support on Titan.

The more interesting aspect of this pattern is that it points to the slowing down of Moore's Law. It would

be awesome to see a completely new graphics architecture every year, but that's not sustainable, and we don't get new process nodes every other year either. The smart business approach is a slow rollout of new parts to keep things fresh, which is exactly what Nvidia has done with Pascal (and Maxwell and Kepler).

The GP100 was announced for Tesla P100 in April 2016 (and the Quadro GP100 as of February 2017); it probably won't ever be a consumer chip, because of the cost of HBM2 and the added FP64 support. While technically second, the GP104 launched in May/June with the GTX 1080/1070, and was the first widely available Pascal implementation. The modestly priced GP106 (GTX 1060 6GB/3GB) then followed in July/August, which also happened to coincide with the GP102 showing up in the professional Quadro P6000. The GP107 (1050/1050 Ti) was released in October, rounding out the budget end of the 10-series parts, and now the GP102 is in the 1080 Ti and Titan Xp.

In other words, Nvidia stretched what would have once been a top-to-bottom launch into a rollout that has spanned the past year. That should carry us to the next-generation Volta architecture, which will still use a 16nm FinFET process. Count on another year for the full Volta

It may look the same, but the Xp boasts improved specs and features.

rollout (Titan TV coming in spring 2019—you read it here first!), and Nvidia should successfully fill the void as we wait for 10nm and 7nm to come online.

There's a second aspect to the Titan Xp and 1080 Ti worth mentioning, and that's the pending arrival of AMD's RX Vega. We should have that in our labs soon enough, but based on early information, I don't expect Vega to be able to beat the 1080 Ti, let alone the Titan Xp. Nvidia is very good at staying on top, and 1080 Ti and Titan Xp are supposed to do just that. I'd love to see an upset, but AMD's RX 500 cards are slight tweaks to the existing Polaris offerings, and Vega will need to see AMD through the next year. It's the graphics card equivalent to Intel's tick-tock model: high-end GPUs in the spring, midrange in the fall, and new architectures every two years.

Jarred Walton has been a PC and gaming enthusiast for over 30 years.



The smart business approach is a slow rollout of new parts to keep things fresh.

play harder

SUPERO™

Server Quality Built for Gaming

7th Generation Intel® Core™ Processor Family

Adopt latest M.2/U.2 PCI-E 3.0 x4 technology

Best IO solution with ultra-fast USB3.1 10Gb/s with type C trend

Optimize SLI/ CrossFire Multi GPU solution

Best Intel® server-grade LAN solution



Server Grade Component

SUPERO components include 15um gold-plated CPU and memory sockets as well as all Nippon Chemi-Con solid capacitors which can run up to 20K hours. 105 degree C design results in leading performance for your gaming PC.



Epoxy Glass Resin PCB

Leveraging SUPERO server grade PCB with TU-662/NP175 materials, the C7Z270-PG-0 will deliver the highest signal integrity for exceptional stability in all conditions, including overclocking.



Power Efficiency

SUPERO motherboards deliver 10% better power efficiency than leading brands.



Server Grade Validation

Server Laboratory Certification confirms SUPERO's ability to deliver a longstanding durability and stability for your Gaming PC. This validation incorporates: Up to 16,000 validating hours, Over 1300 validation items and Over 300 WW Lab engineers.



Intel Inside®. Powerful Productivity Outside.

WHERE TO BUY :



Learn more at www.Supero.com



Alex Campbell

OPEN SOURCE

No Privacy for You!

PEOPLE ON FORUMS, social media, and good old IRC love to argue. If you get a bunch of techies to actually step out of their respective bubbles to talk, arguments ensue. Red versus Blue, ninjas versus pirates, Macs versus PCs, Windows versus Linux—you get the idea. If there's one thing tech enthusiasts do agree on, it's that their privacy should not be infringed.

If you liked the fact that the FCC was going to restrict an ISP's ability to track your DNS requests and browsing habits so that an ISP couldn't sell said data to the highest bidder, the US Senate majority gave users a big middle finger at the end of March. The implications for this are huge, mostly because just about everyone in the United States relies on an ISP, whether that's the cable or DSL line to their house, or their mobile carrier. All of that personal usage data has been vacuumed up, and that's set to continue for the foreseeable future.

There's a big difference between an ISP scooping up data and a service such as Facebook or Twitter. Facebook et al. are opt-in; you sign up. You can still use the Internet without signing up for their service. An ISP is a gatekeeper to the Internet itself. Without going through an ISP, you can't get online. Period.

There are things users can do. I've often written about using a VPN whenever connecting to a dicey open Wi-Fi location. If the rules going forward do not allow users to opt out of data collection, using a VPN at home may be a necessity if you value your privacy.

The problem with that is that VPNs often slow down traffic, due to the overhead of encryption and the need to funnel data through a single location where the VPN servers are located.

The other problem is that, unlike ISPs, VPNs are largely unregulated, and you have to shift trust from your ISP to a VPN service. If you're looking for a VPN provider, look long and hard at the privacy statement



There's a big difference between an ISP scooping up data and a service such as Facebook or Twitter.



NetworkManager makes choosing and connecting to a VPN a snap.

to ensure that it doesn't keep logs or share data with third parties. If you're even more paranoid about having your metadata accessed, such as your billing information, find a VPN that accepts gift cards as payment.

And the last thing that will annoy you about having to use VPNs is that they are inconvenient. The minute you connect to your VPN, you're cut off from your own LAN. I always forget to turn off my VPN connection on my phone when trying to turn off my Philips Hue bulbs, and it drives me nuts. The most seamless solution is to use a router that connects to a VPN with its Internet-facing Ethernet port. Not all routers do this, and most routers that tout VPN features actually imply that

they can host an OpenVPN server, not connect to one.

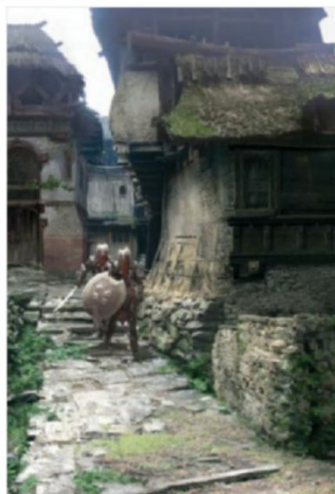
Finally, be sure to find a VPN provider that uses the OpenVPN protocol. OpenVPN is a modern open-source protocol that's more secure than the older PPTP. Linux users can find OpenVPN client plug-ins for NetworkManager in most repos. Windows users can download a VPN client from <http://openvpn.net>.

You can also choose to use Tor, though its performance hits often exceed those of a decent VPN. But again, for the paranoid, Tor will keep your browsing more anonymous.

Alex Campbell is a Linux geek who enjoys learning about computer security.

THE LIST

INTEL'S BIGGEST CANCELLATIONS



6

PROJECT OFFSET

Intel acquired game developer Offset Software in 2008, and the first-person shooter it was creating at the time. The game was canned in 2010, although the engine was used by Red 5 Studios



3

LARRABEE

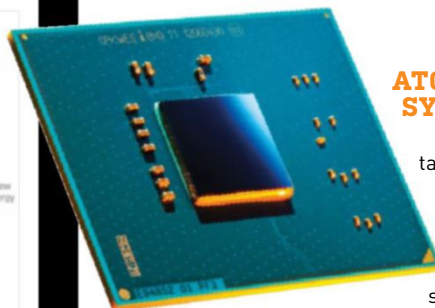
Intel's attempt at serious desktop graphics underperformed as it was nearing release, and so was dropped. Intel's integrated graphics continue to improve, though, so not all was lost.



5

TICK-TOCK CYCLE

From 2006, Intel's CPUs adhered to its strategy of a new fabrication process (tick) followed by a new microarchitecture (tock). This has been replaced by the company's Process-Architecture-Optimization scheme.



2

ATOM "BROXTON" SYSTEM-ON-CHIP

The Atom brand has taken many low-power forms, but the "Broxton" SoC was aimed squarely at the tablet and smartphone markets, only it was a little too late, so got the chop.

4

"TEJAS"

The original follow-up to Pentium 4 was canceled due to its high heat output (150W at 2.8GHz). This death did help push the Core 2 architecture forward, though.



1

IDF 2017

The Intel Developer Forum was a great showcase for the company's products, and for getting the low-down on the latest tech. To be replaced with smaller events, apparently.



Your new source for Raspberry Pi

Future

ON
SALE
NOW



DELIVERED DIRECT TO YOUR DOOR

Order on line at WWW.MYFAVOURITEMAGAZINES.COM
or find us in your Supermarket, Newsagent or Bookstore

HEAD TO

BY JEREMY LAIRD

TN vs. IPS vs. VA

Choosing a panel type used to be simple. You chose TN if you were cheap or wanted to game, or IPS for almost everything else. Now, it's not so easy. The best TN tech has improved dramatically, though the benefits have only touched a minority of monitors. Meanwhile, IPS panels have become far cheaper, and VA tech keeps throwing in that high-contrast curve ball, thus offering a flawed but compelling alternative. Meanwhile, the PC is now so capable that the range of uses and applications, not to mention screen sizes and resolutions, are so varied that the pros and cons of the three main panel techs are more nuanced than ever.

ROUND 1

Gaming

If there's a single application type you can rely on to hammer your PC into whimpering submission, it's gaming. No surprise, therefore, to find it's gaming that makes for quite the conundrum when it comes to choosing panel tech.

On the one hand, you want zingy colors, plus plenty of pop and contrast in your games, right? VA it is, then. Of course, color accuracy also counts, especially when it comes to picking out enemies in shadowy, low-contrast scenes. Better make it IPS. But hang on, you also want zippy pixel response, the highest possible refresh rates, and the absolute minimum of input lag. Can we change that to TN, after all?

Whatever you go for will be a compromise. For instance, the latest IPS monitors aimed at gamers have begun to adopt refresh rates of 120Hz and more. Likewise, panels of all types can be had with frame-synching and performance-smoothing Nvidia G-Sync and AMD FreeSync tech. But in the end, the most rewarding gaming screens are the ones that handle motion best. And that undeniably means TN. The good news is that TN has come on a lot in terms of colors and contrast of late. So, it's not the bum steer it used to be by those broader metrics.

Winner:
TN

ROUND 2

Video Playback

You could argue that any LCD technology is doggie do when it comes to video playback. Shining a light through a huge number of imperfect shutters is a pretty dumb idea compared to an OLED panel, say, where each pixel is its own light source. And yet LCD technology has developed to the point where it has very nearly—but not quite—shaken off its inherent shortcomings.

For watching video, that means a number of things. Colors and contrast are super-important for pure visual pizzazz, and VA, with its super-high contrast capability, scores heaviest and delivers the most superficially impressive results with video. IPS technology has closed much of the gap when it comes to contrast, but the specs do not entirely lie. VA panels with static contrast capability of 3,000:1 or more are now common. That is simply beyond the capabilities of IPS tech.

However, accuracy also counts, especially if you like a more natural vibe with your video and movies. In that scenario, IPS tech works best. Of course, pixel response is also important, given that video involves motion. But the downsides that TN brings to video in pretty much all other regards rule it out of the running in this category.

Tie:
IPS and VA

ROUND 3

Content Creation

Of all the categories here, content creation is probably the only one for which the preferred panel technology is a near 100 percent nailed-on certainty. It's IPS you want. That's because IPS is comfortably the most accurate LCD panel technology available.

The point is that IPS gives you the best chance of ensuring that whatever content you're producing at your end looks right when it's consumed at the other end. If you want to color correct for print, for instance, it's the obvious choice. Admittedly, if some of your audience insists on using substandard viewing devices—perhaps a PC with a wonky TN panel—there's only so much you can do. But the point remains: IPS is the way, the truth, and the light for accuracy.

If there are exceptions, the first would involve cost. Aside from accuracy, having a high native resolution is desirable in terms of being able to view large images and high-definition video within the bounds of an editing app. And that can be expensive with an IPS panel. At least, it used to be. The cheapest 27-inch 4K IPS monitors are now roughly only 10 percent more expensive than a TN equivalent. IPS is pretty much a no-brainer, therefore.

Winner:
IPS

HEAD



ROUND 4

General Desktop Use

Want a horse? Then you'd better know the course. And so it is for choosing a panel for general desktop use. Much depends on your preferred mix of apps, your viewing environment, and your budget.

Not too long ago, cheapskates could find great value in something like a 4K TN panel. TN tech in that format offers surprisingly good colors and contrast, and the 4K res provides oodles of space for juggling app windows. More recently, however, IPS and VA prices have tumbled, and the price delta has dwindled to decidedly insignificant proportions. And so the choice narrows to IPS and VA.

For general use, though, IPS has the edge. That's primarily down to superior viewing angles. It's not that VA viewing angles are poor per se, but the consistency of IPS makes for a more pleasant general computing experience. It just feels right, while VA, on the other hand, is superficially punchier, yet ultimately less pleasing to the discerning eye. The exception might be using a panel in extreme ambient light conditions, be that exceptionally bright or dark. In both cases, you might then lean toward choosing VA. In bright conditions, the extra pop is welcome; while in a very dark environment, you'll appreciate the reduced backlight bleed.

Winner:
IPS

ROUND 5

Web and Office

For web and office work, it's all about the pixels—or, more specifically, how many of them your screen has. It's actually a more complex question than you may at first consider, given that you have to factor in both the actual resolution in horizontal and vertical pixels, and then the panel size. Together, that determines the pixel pitch.

The problem, in this particular context, is that the world of computing isn't yet entirely, you might say, DPI agnostic. In other words, much of the web, and even some bits of the Windows GUI, are based on static bitmaps, which scale poorly if you bump the Windows DPI setting away from 100 percent. That can make for problems with very high DPI screens. Go for, say, a 24-inch 4K screen, and you'll be forced to choose between wonky Windows elements and blurry bitmaps on the one hand, or stupid-small fonts and icons on the other.

The final reckoning for this category doesn't map terribly well to panel type. However, if you can afford it, the accuracy of IPS, combined with high resolution at the right panel size, is the optimal choice. But both VA and TN technology can make for pleasant enough web and office partners.

Winner:
IPS

And the Winner Is...

If there can be only one winner, then it has to be IPS. It's not the best panel tech by each and every metric—VA panels offer superior contrast and superficial pop, while TN screens are faster—but IPS's overall balance of qualities simply cannot be beaten.

Indeed, it's actually when you put all the objective tests to one side and simply absorb the look of a screen that IPS scores most heavily. Monitors using other panel technologies often have a certain wow factor—for instance, the punchy colors or deep contrast of a big VA panel—but if you discover the *Maximum PC* crew huddling around the latest LCD marvel, and quietly muttering, "My God, that is lovely," it's almost always an IPS panel.

Of course, there are exceptions. If speed is critical, TN still rules. Likewise, at any given price point and form factor, there may be conspicuous bargains that push the value proposition toward either VA or TN. However, as pricing continues to converge, that's less often the case. As Principal Rooney said, les jeux sont faits for other screen techs. Translation: Choose IPS. 🔄

DOCTOR

THIS MONTH THE DOCTOR TACKLES...

- > Cooling Science
- > Partition Work
- > Windows 10 Growth

Windows 10 Grows

Hi Doc, I'm a long-time reader, and I always look forward to your column. I have two questions. First, in the January issue, there was an article that covered creating Windows 10 recovery media. I followed the instructions and used the Windows media creation tool, intending to burn a DVD, but received a message that the image was too large for my disc.

Then I tried using Windows' Recovery Drive creation tool (Windows 10 Pro 64-bit). I had a 16GB SanDisk Cruzer Glide in my USB port, and started the utility. After a couple of clicks, a message told me to "Please wait," with a moving progress bar. But the bar stopped with an error that said, "We can't create the recovery drive. A problem occurred while creating the recovery drive." It didn't give me any information about the problem or how to solve it. My only storage drive on this system is a 750GB Samsung 840 EVO SSD. Any ideas?

My second question is this: I'm putting a parts list together for my next PC, based on the Kaby Lake architecture and Intel's Z270 PCH. It's shaping up well for the most part, but I'm hoping



M.2, PCIe, and U.2 are best for fast storage.

you can clear up the current storage landscape. Between M.2, U.2, NVMe, SATA, and PCIe, my head is spinning (no pun intended). What would the best-performing drive interface be for this new system? **—Steve Vanetti**

THE DOCTOR RESPONDS: By Microsoft's own admission, the company recently refreshed its Windows 10 media, which put the ISO file's size over the capacity limit of a single-layer DVD. Now you'll need a flash drive (8GB-plus) or a blank dual-layer DVD.

When you fire up the media creation tool, choose the "Create installation media for another PC" option. Microsoft will likely suggest a language, edition, and architecture based on your hardware. If you'd like to change any of those, uncheck "Use the recommended options for this PC," and click "Next." The following screen lets you create a bootable USB flash

drive or download the actual ISO. Although the Doc likes to keep ISOs on a storage server for safe-keeping, you may not share the same compulsion. In that case, leave the default selection, plug your drive in, and proceed. You're warned that files on the drive will be deleted, and asked to choose a drive letter/device. Once you move to the next screen, Windows starts downloading.

As far as storage is concerned, it may be easiest to explain with an example. Let's start with MSI's Z270 Gaming Pro Carbon motherboard, if only because the Doc has one sitting in front of him as he writes this. The board's specs claim support for six SATA ports, two M.2 slots, and an optional Turbo U.2 Host Card.

The SATA ports provide up to 6Gb/s, or roughly 600MB/s, of peak throughput. Many modern SSDs hit that ceiling during sequential transfers, so they're already a bottleneck. The M.2 slots support SATA, too, but in a different form factor (M.2-based SSDs look like sticks of gum lying down on your motherboard). Here's where things get tricky, though: MSI's M.2 slots also accommodate SSDs designed to communicate over PCI Express. Four lanes of third-gen PCIe give you 32Gb/s

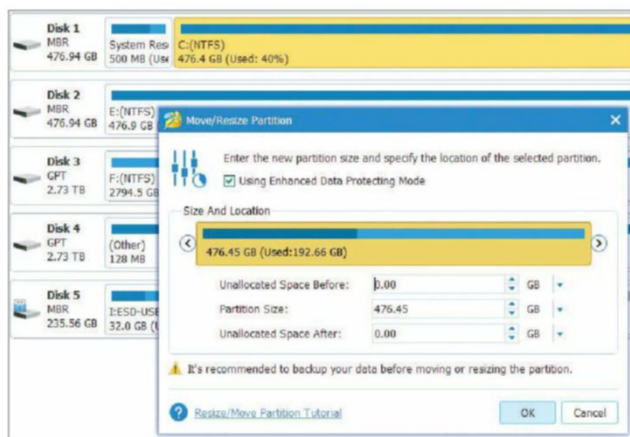
to work with. There's always the option to plug a PCIe SSD into an expansion slot on your motherboard, or MSI sells a Turbo U.2 Host Card separately. The U.2 interface is similar to M.2 in that it enables up to four lanes of third-gen PCIe. But it takes the connection off your motherboard, enabling you to attach an ultra-fast SSD using a cable.

If performance is top priority, PCI Express-based storage using the NVMe protocol rules. It maximizes bandwidth and minimizes latency compared to SATA and the old-school AHCI protocol. As such, the drive you're looking for will drop into an M.2 slot, occupy a PCIe add-in card, or plug into a U.2 port. The form factor you choose is largely a matter of personal preference.

Partition Manipulation

Doc, I thought I could do almost anything on a computer, but the more I research this, the less confident I am. I have Windows 10 (build 1511) and want to upgrade to build 1607. When I try, I get a message that says, "We couldn't update the system reserved partition." Is there a reasonably safe way to expand that partition? I looked at Partition Magic and another

submit your questions to: doctor@maximumpc.com



Work around system reserved partition size issues with MiniTool.

package I can't remember the name of—neither appeared capable of doing the job.

—Joel Vignere

THE DOCTOR RESPONDS: It should be possible to extend your system reserved partition. First, back up all your important files to another device. There are no guarantees this process will work the same way on your machine as it did on one of the Doc's test beds. Proceed with caution, understanding that fiddling with partitions can result in data loss.

If you're willing to accept the risk, download an app called MiniTool Partition Wizard Free. The utility gives you a Windows Disk Management-like look at your storage subsystem, but with far more flexibility. One of its capabilities is labeled "Move/Resize Partition." Use that to shrink your operating system partition a bit. Then, click the "Extend Partition" feature to make the system reserved partition larger.

The Doc's native Windows 10 installations all have 500MB system reserved partitions, so that might good to aim for.

GPU Upgrade

Hi Doc, I'm planning a Socket AM4-based build using a Ryzen 7 1700X or Ryzen 5 1600X. I own an Acer Predator XB271HU 144Hz G-Sync monitor and an EVGA GeForce GTX 1070 graphics card.

As much as I would love to buy a new GeForce GTX

1080 Ti, it's simply out of my price range. So, should I snag another 1070 and run in SLI, or upgrade to a 1080? I play first-person shooters such as *Doom*, *Battlefield*, and *Call of Duty*.

—Daryl Austin

THE DOCTOR RESPONDS: On its own, your GeForce GTX 1070 is fast enough to play most games at 60fps or more, using the top quality settings at your monitor's native 2560x1440 resolution. However, you undoubtedly want even higher performance, given that display's 144Hz refresh rate.

SLI is a viable option. In DirectX 11-based games, adding a second GPU should yield impressive scaling. But be aware that the benefits of SLI are often less pronounced under DirectX 12. Further, there's not much support for multi-GPU rendering in today's VR games. Given the diminished attractiveness of these configurations, the Doc would recommend against a second 1070.

At \$500, the least-expensive GeForce GTX 1080s are certainly more affordable than they were pre-1080 Ti. Still, \$500 is a hefty sum for a fairly modest step up. Re-evaluate the performance you're seeing after piecing together that Ryzen-based configuration and try to stay patient. After all, Vega will change the graphics landscape soon, either by wooing gamers or justifying a wave of new GeForce sales.

The Science of Cooling

Good morning, Doctor. Why don't CPU cooler manufacturers rate their products based on the watts of heat they can dissipate?

I have a 220W AMD processor that I cooled for several years using Cooler Master's Hyper 212 EVO. I recently read that it needs liquid cooling. Due to the size of my case, though, I went with a 120mm radiator platform. After installing NZXT's Kraken X31, the CPU seems to be running hotter than before. Now it crashes when I play *Doom*, where it was fine previously. Does the X31 have less capacity than the Hyper 212? I am running the X31 in performance mode, and installed another fan in a push/pull configuration.

This system will go to my son once I upgrade to Ryzen. Currently it sports a Radeon R9 280. Is it worth buying the Radeon RX 480? —Ray Brown

THE DOCTOR RESPONDS:

Excellent question, Ray. The Doc took your inquiry to the knowledgeable folks at Corsair, where senior project manager Bobby Kinstle helped address it: "The heat capacity of a liquid cooler varies with a bunch of other factors, including what it's attached to and how. The numbers I could come up with would sound big, but are ultimately meaningless. Case in point: the H100i set to full speed, with heat directly applied to the cooler as efficiently as possible,

has a heat capacity of several thousand watts before the plastic melts. At such extreme power levels, however, other variables come into play. For instance, the thermal grease may exceed its absolute heat capacity first.

"Chip packaging is often the biggest thermal resistance to overcome. Heat is generated in a very thin layer on the silicon, but then has to conduct to a copper cap via thermal grease or solder. Next, the cap has to conduct the heat and hopefully spread it out a little (but not much, since it's only 1mm thick). Heat has to pass through another layer of thermal grease atop the heat spreader, after which it can enter the cooler. Recent CPUs with thermal grease inside of them can hit their thermal conductivity limits at power levels as low as 200W. Intel's Core i7-4790K is a famous example of this. Overclocked, it's almost impossible to cool with systems running at ambient. That's why you often see die temps in the 55–60 C range with only 95W loads.

"Now, take the same cooler and put it on a 250W Titan X. We'll see die temperatures around 35 C. In this example, the die is much larger, reducing the heat flux per square millimeter. Also, the silicon is in direct contact with the water block through just one layer of thermal grease [a very poor conductor of heat compared to metals]."

So, yeah, there are a lot of factors that go into defining cooling performance other than heat capacity. In your specific case, the Hyper 212 EVO is undersized for something like an FX-9590, whereas an X31 should be fine. If you're seeing higher temperatures with the NZXT closed-loop liquid cooler, there may be a problem with the hardware itself or your installation (insufficient or uneven pressure on the CPU?).

As for graphics, the Radeon RX 480 represents a respectable upgrade over the R9 280, particularly if your son plans to game at 2560x1440. ↻



MSI's Z270 Gaming Pro Carbon supports a Turbo U.2 Host Card.



Windows 10

CyberPowerPC recommends Windows.
One experience for everything in your life.

Gamer Extreme XT



Windows 10 Home

Intel® Core™ i7-6800K Processor

GIGABYTE® X99 Chipset Mainboard
16GB DDR4 2400MHz Quad Ch. Memory
240GB SSD + 2TB SATA III 6.0 HDD 7200RPM
NVIDIA® GeForce® GTX 1070 8GB Video Card
Cyberpower Aula Gaming Headset
In Win 303 Gaming Case + 600W 80+ PSU
Asetek Liquid Cooling System



HD 7.1 600W



Cyberpower



Cyberpower

FROM
\$1599



Liquid Cooling
FREE

Vector II-Z VR600



Windows 10 Home

Intel® Core™ i7-7700HQ Processor

Intel® HM170 Express Chipset
15.6" FHD IPS Non-Reflective 1920 x 1080
NVIDIA® GeForce® GTX 1070 8GB
512GB Intel 600p M.2
RGB Programmable Gaming Keyboard
16GB DDR4 2133 2X 8GB
Gigabit LAN, HDMI 2.0m, MiniDP
Intel® Dual Band Wireless-AC 8260

FROM

\$1529

15.6" HD



8X DVD ±RW



250 Mins



Bluetooth 4.2



1x USB 3.0
1x 3.1 Type C

HDMI 1.4

HD 30FPS Webcam

Mini-DP 1.2

5.29 Lbs.

Vector II-Z VR700



Windows 10 Home

Intel® Core™ i7-7700HQ Processor

Intel® HM170 Express Chipset
15.6" FHD IPS Non-Reflective 1920 x 1080
NVIDIA® GeForce® GTX 1070 8GB
1TB INTEL 600P M.2
RGB Programmable Gaming Keyboard
16GB DDR4 2133 2X 8GB
Gigabit LAN, HDMI 2.0m, MiniDP
Intel® Dual Band Wireless-AC 8260

FROM

\$1685

17.3" HD



8X DVD ±RW



250 Mins



Bluetooth 4.2



1x USB 3.0
1x 3.1 Type C

HDMI 1.4

HD 30FPS Webcam

Mini-DP 1.2

5.96 Lbs.



ORDER TODAY! **800.707.0393**
www.cyberpowerpc.com

Cortana available in select markets at launch, experience may vary by device.
*External monitor must support HDMI input. (If continuum-compatible accessory is not included, add "Accessories sold separately.") **App availability and experience varies by device and market. Office 365 subscription required for some features. *Limited to select premium phones at launch. Feature and app availability and experience may vary by market and device. Windows Hello required specialized hardware, including fingerprint reader, illuminated IR sensor or other biometric sensors.

Work easy. Play hard.



Windows

Intel Inside®. Amazing Experience Outside.



FREE LIQUID COOLING

CPUs with standard fansinks can reach core temperatures as high as 130°C, however, liquid cooling can lower that to 59°C giving you better performance and longer lifespan on your CPU.

\$54.99
VALUE

Gamer Xtreme 2000



Windows 10 Home

Intel® Core™ i3-7300 Processor

GIGABYTE® Z270 Chipset Mainboard (USB 3.1)
Corsair® 8GB DDR4 2400MHz Dual Ch. Memory
1TB SATA III HDD 7200RPM
NVIDIA® GeForce® GTX 1050Ti 4GB Video Card
Cyberpower Aula Gaming Headset
Phanteks Eclipse P400 with tempered glass
Gaming Case + 600W PSU
Asetek Liquid Cooling System



FROM
\$799



HD 7.1



Cyberpower



Cyberpower

Gamer Xtreme 3000



Windows 10 Home

Intel® Core™ i7-7700K Processor

GIGABYTE® Z270 Chipset Mainboard (USB 3.1)
Corsair® 16GB DDR4 2400MHz Dual Ch. Memory
240GB SATA III SSD Boot Drive
2TB SATA III 3.0 HDD 7200RPM
NVIDIA® GeForce® GTX 1070 8GB Video Card
CyberpowerPC Aula Gaming Headset
Phanteks Enthoo Pro M Gaming Case +
600W 80+ PSU
Asetek Liquid Cooling System



FROM
\$1499



14x Optical Drive



HD 7.1



Cyberpower



Cyberpower

Gamer Infinity 8800 Pro SE



Windows 10 Home

Intel® Core™ i7-6800K Processor

GIGABYTE® X99 Chipset Mainboard
Corsair® 32GB DDR4 2400MHz Quad Ch. Memory
240GB SATA III SSD Boot Drive
3TB SATA II Data Hard Drive
NVIDIA® GeForce® GTX 1080 Ti 11GB Video Card
CyberpowerPC Aula Gaming Headset
NZXT H440 Design by Razer Gaming Case +
600W 80+ PSU
Asetek Liquid Cooling System



FROM
\$2315



HD 7.1



Cyberpower



Cyberpower

Syber M Pro 200



Windows 10 Home

Intel® Core™ i5-7600K Processor

GIGABYTE® Z270 Chipset Mainboard with USB 3.1
CORSAIR® 16GB DDR4 2400MHz Dual Ch. Memory
240GB SSD + 2TB SATA-III 3.0 HDD 7200 RPM
NVIDIA® GeForce® GTX 1060 3GB Video Card
Cyberpower Aula Gaming Headset
Syber M Series Gaming Case 600W 80+ PSU

FROM
\$999



HD 7.1



Cyberpower



Cyberpower

Order your **ultimate gaming system** today! www.cyberpowerpc.com

730 Baldwin Park Blvd., City of Industry, CA 91746

All Desktop systems come with 3 year Limited Warranty + lifetime toll free techsupport

CyberPowerPC, CyberPowerPC Logo and, Unleash The Power are trademarks of CyberPower Inc. Copyright © 2013 CyberPower. All rights reserved. All prices are subject to change without notice or obligation. Celeron, Celeron Inside, Centrino Inside, Centrino Logo, Core Inside, Intel, Intel Logo, Intel Core, Intel Inside, Intel Inside Logo, Intel vPro, Itanium, Itanium Inside, Pentium, Pentium Inside, vPro Inside, Xeon, and Xeon Inside are trademarks of Intel Corporation in the U.S. and other countries. All prices are subject to change without notice or obligation. CyberPower is not responsible for any typographical or photographic errors. NVIDIA®, nForce®, GeForce®, SLI™ are trademarks or registered trademarks of NVIDIA Corporation or its subsidiaries in the United States and other countries. CyberPower PCs use genuine Microsoft® Windows®, www.microsoft.com/piracy/howtotell

RYZEN MOTHERBOARDS UNWRAPPED

We take a look at the very best Ryzen has to offer. *By Zak Storey*

SO, HERE WE ARE: the dreaded annual motherboard supertest. A new architecture and a new platform, filled with uncertainties, early BIOS versions, and all sorts of bugs, errors, and crashes to contend with. An absolute swamp of auto-asphyxiated hell for any hardware reviewer. Indeed, many across the industry have dreaded this day, because it means the suspension of sanity for at least two weeks.

Why do we put ourselves through this? We do it for you, our readers, and, of course, because we're fired by the rampant curiosity that drives each and every human being. It's rather like asking, "What is the meaning of life?" or "What did 1998's McDonald's Szechuan sauce actually taste like?" We simply have to know which motherboard is best, and—more importantly—which board is right for you.

With Ryzen, AMD has positioned itself in a particularly odd place within the marketplace. By default, the processors themselves compete quite happily with the bulk of Intel's Broadwell-E, high-end desktop platform on performance, at both

single and multicore performance, decimating chips that cost almost \$700 more than the lowest-end seven series chip. However, the chipset is more akin to that of a mainstream Z170 Skylake motherboard, harboring nowhere near the number of direct PCIe 3.0 lanes, SATA, or M.2 compatibility that its pricier competitor offers. Take it out of the ecosystem entirely, and it even pales in comparison to that plucky blue, over-priced, under-runner from yesteryear.

What does that mean, exactly? To be frank, not a lot. Although Ryzen's chipset does look somewhat weaker than its Intel counterparts, you have to take into account what people are actually making use of. For the vast majority, a single M.2 PCIe SSD, a full bank of SATA, and two GPUs running in x8/x8—that's all you're probably ever going to need. Especially when you take into consideration the fact that Nvidia isn't even supporting more than two-way SLI anymore.





THE AM4 PLATFORM

AMD's latest motherboards picked apart for your reading pleasure

THE CHIPSETS

Ryzen has a total of five chipsets, each aimed at a different audience. There's the top-end X370 chipset, featuring high-end support for storage, NVMe devices, and overclocking by default. The B350 is a slightly slimmed down variant of X370, with SLI/Xfire disabled by default, but still coming overclocked. Then there's the more budget-oriented A320, with even less USB support, and overclocking disabled. Finally, there are two unreleased chipsets we haven't seen yet, designed to deal with small form factor devices: X300 and A300.

Although we haven't seen any X300 or A300 motherboards, their position is

actually the most interesting question. Reason being, we've already seen Biostar produce an X370 ITX motherboard—arguably one of the smallest mainstream form factors currently available to the computing ecosphere. So, we simply can't tell at this point how these X300 and A300 chipsets will fit into the climate. However, judging by the limited USB support, and almost non-existent SATA Express support, it could hint at an even smaller motherboard form factor coming down the pipeline, specifically for console-like devices. A potential possibility for the PS5 or Xbox Two? Only time will tell.

AVAILABILITY

At the moment, availability isn't stellar for the fledgling motherboards, with many AIB partners claiming that they weren't given enough time or warning about the readiness of Ryzen processors. Most expected 1,000 chips in the first batch, with 10,000 the following month. In fact, AMD launched with 10,000 chips, followed by over a million in the second batch.

Right now, there are 16 X370 boards, ranging from \$120 up to \$330, all of them ATX; 19 B350 mobos, in a combination of ATX and microATX, available from \$70 to \$132; and a single A320 board, the Gigabyte GA-A320M-HD2, at \$70.

A FULL BREAKDOWN OF AMD AND INTEL'S CHIPSETS

Chipset Segment	Chipset	USB 3.1	USB 3.0	USB 2.0	SATA 6Gb/s	Memory Channels	Number of PCIe 3.0 Lanes on Chipset	Max Number of PCIe 3.0 Lanes on CPU	Hypothetical NVMe PCIe SSD Maximum	Maximum GPU Config	Overclocking
AMD Enthusiast	X370	2	10	6	6	Dual-channel	0	16 GPU + 4 SSD	x1	x8/x8	Yes
Intel Enthusiast	X99	0	6	8	10	Quad-channel	0	40 GPU/SSD	x6	x16/x8/x8/x8	Yes
AMD Performance	B350	2	6	6	4	Dual-channel	0	16 GPU + 4 SSD	x1	x16	Yes
Intel Performance	Z270	0	10	14	6	Dual-channel	24	16 GPU	x6	x8/x8	Chip-dependent
AMD Mainstream	A320	1	6	6	4	Dual-channel	0	16 GPU + 4 SSD	x1	x16	No
Intel Mainstream	H270	0	8	14	6	Dual-channel	20	16 GPU	x5	x16	No

THE X399 RUMOR MILL

Even though AMD has only just dropped Ryzen into our laps, the rumor mill is still churning away, suggesting that the redheaded company is planning to launch an HEDT variant of both its processors and chipsets later this year, around about the time Computex occurs in Taiwan. The theory is that these are going to be cut-back variants of AMD's latest Naples server architecture. Coming in 16, 12, and 10-core variants, the processors should absolutely demolish video rendering and more CPU-intensive computational tasks.

If the chips are anything like their Naples counterparts, you can expect AMD to take advantage of that server-based infrastructure, forsaking the chipset, and instead opting for anywhere between 48 and 64 PCIe 3.0 lanes directly on chip. We're still not absolutely sure whether this is going to be an LGA socket, like Naples, or operate on Ryzen's more commonplace AM4 PGA socket solution.... But, why would we

even need this new HEDT variant of Ryzen? Especially when the cores already compete so well with their ridiculously more expensive Intel competition? Well, in short, X399 would act as a bridge between the nonsensical server prowess of AMD's Naples SoC platform and Ryzen's X370 gaming/rendering aspirations. For those not interested in smashing out the frame rates, but rather rendering at a professional level, X399 should provide the key. In contrast to the Ryzen 7 1800X, these chips should offer quad-channel memory, better PCIe support, and far lower clocks, leading to increased power efficiencies in the process.

For the time being, this is still all speculation, but consider our interest piqued if this does come to fruition. And to be quite frank, a 16-core Ryzen chip coming in at the same price as an Intel Core i7-6900K should demolish the competition when it comes to those highly demanding applications.

THE GOOD, THE BAD, AND THE ODD

Analyzing exactly what's going on with AMD's AM4 chipsets

THE GOOD

From the get-go, it would seem that AMD is already on the back foot when it comes to chipset connectivity. Lacking PCIe 3.0 lanes on the chipset, and with limited SATA and USB support (regardless of its USB 3.1 additions), it doesn't look particularly fabulous for team red.

But then you have to ask, when has anyone ever used the full complement of motherboard connectivity? When you break it down, those looking to take advantage of 10 or more SATA hard drives, multiple M.2 PCIe SSDs, and so on are already looking at the higher-end platforms in the form of the X99 series and server-grade solutions. For the vast majority of consumers and anyone on a budget, a single M.2 PCIe SSD and four SATA 6Gb/s ports are more than enough for the lifetime of any system, even including any potential future upgrades and expansions. It's why we quite often recommend the ITX form factor over ATX, purely because you simply don't need that level of excess.

The true beauty of the AM4 platform stems once more from the processor itself. Although it's not the first time we've seen a full complement of I/O directly on the chip, as opposed to the chipset, it's the first time we've seen it available at such a low price point, with each and every Ryzen 7, 5, and 3 series featuring 20 PCIe 3.0 lanes. Sixteen of those are dedicated to graphics, similar to Intel's current design, and an additional four are isolated purely for NVMe or SATA devices, reducing latency between the device and the chip.

THE BAD

That said, even including the dedicated PCIe lanes on the chip, AMD is still lacking when it comes to general connectivity. With X99 retaining its heady title, purely through sheer force of will, and its vast arsenal of PCIe lanes and USB/SATA support, it's still a major selling point for any 3D professional or artist. It's likely that over the next year or two, we'll see PCIe M.2 SSDs plummet in price, making a 500GB M.2 relatively close to good value for money. Running two PCIe SSDs in a single system represents an upgrade path that just isn't available with the current generation of X370 motherboards, unless, of course, X399 drops sometime soon, or until we see the next generation of Ryzen chips: Ryzen 2.

In its own way, this lack of I/O support for the chipset is particularly interesting, because AMD has explicitly stated that it intends to keep that "upgrade the chip not the mobo" motto, retaining the AM4 socket for the entire lifetime of the architecture, until either DDR5 or PCIe 4.0 launches. This would suggest that, as connectivity standards have dramatically increased over the last few years, with no sign of stopping, it's likely that with each new generation of AMD Zen core, we'll see an update of all the associated chipsets, with either more I/O baked into the chipsets, or even more leveraged on to the processors.

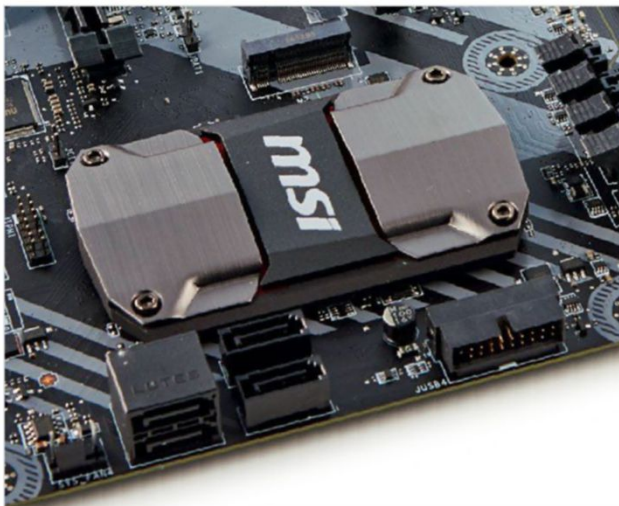
That said, if you're after the best of the best, you're still stuck with Intel's X99 platform, unless AMD's X399 chipset platform becomes a reality.

THE ODD

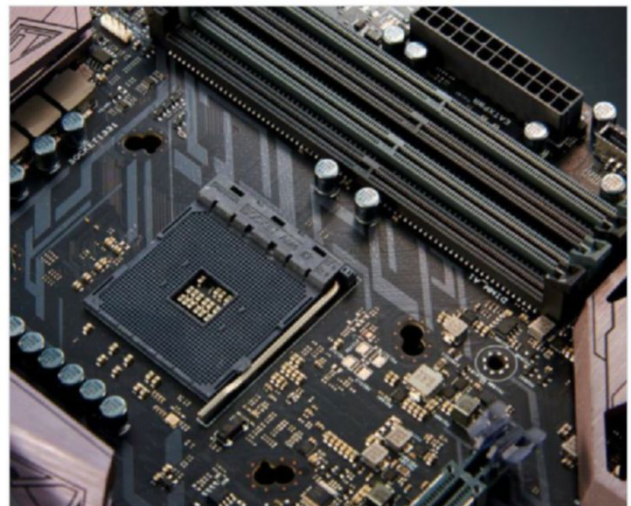
The AM4 socket and Ryzen represent the pinnacle of what AMD has managed to achieve with Zen. But there are two huge anomalies when it comes to the general platform: LGA and PGA. LGA stands for Land Grid Array—in short, the pins are located in the motherboard's socket, not the processor. With PGA, Pin Grid Array, it's the other way round.

Generally speaking, Intel has always been a solid advocate of the LGA solution. The biggest advantage of this comes down to the fact that it's quite difficult to damage the processor, or for it to be trashed through shipping. With an LGA solution, the AIB partners, such as Asus, EVGA, MSI, and others, will likely RMA more motherboards, as the sockets get damaged in transit or through user error. In AMD's case with PGA, the scenario is reversed. With the chip holding the pins, it's highly unlikely that you'll damage the motherboard, but more likely that the chip can be damaged, leading to more processors being sent back to AMD, and savings provided directly to the partners.

The thing is, these standards aren't owned by either company. And, in fact, with Ryzen, AMD is using both PGA and LGA for its processors—PGA for the 7 series and below, and LGA for its Naples SoC (System on Chip) server parts. There has been no official statement about why this is, but it's a curious change nonetheless, something that may allude to a paradigm shift in AMD's future processor lineup, way after Ryzen's heyday.



X370 and B350 are king, but we really wish there were more I/O.

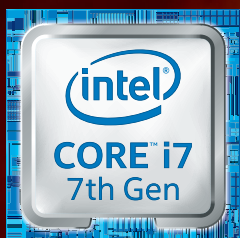


AMD's PGA socket has been a staple for years, but is it about to end?

BLAZING PERFORMANCE!



Sager
recommends
Windows.



Intel Inside®
Extraordinary
Performance
Outside.



Windows 10

NP9876 Notebook **\$2,999**

FREE UPS GROUND SHIPPING*

- Windows 10 Home
- 7th Generation Intel® Core™ i7-7700K Processor
- 17.3" 3K QHD, 120Hz 5ms Matte Display (2560x1440) w/NVIDIA® G-SYNC Technology
- NVIDIA® GeForce™ GTX 1080 8GB GPU
- Opt. Dual NVIDIA® GeForce™ GTX 1080 GPUs
- 16GB Dual Channel DDR4-2400MHz Memory
- 500GB Samsung 850 EVO M.2 SSD + 1TB 7200RPM Hard Drive
- Full Color Programmable backlight Keyboard
- Killer DoubleShot-X3™ Pro with Smart Teaming (2X 1000Mbps LAN + Killer Wireless-AC 1535)
- Thunderbolt Gen3/USB 3.1 Type-C Combo Ports
- Built-in 2.0M FHD Camera & Fingerprint Reader
- Headphone output w/ESS SABRE HIFI Audio DAC

Dealer/VAR, Government and Corporate pricing are available. Please call for details.

Sager One Year Limited Warranty Policy: 30-Day Money-Back Guarantee. If the equipment does not work as promised, or if you are not fully satisfied, we will issue a full refund upon the return of all original equipment. 1-Year Parts and Labor Limited Warranty. Lifetime Toll-Free Technical Support. Sager One Year Limited Warranty, Two Year Limited Warranty and Three Year Limited Warranty Policy Applies to End Users in the United States of America only. Extended Warranty Available: Check out this comprehensive package of service/support. Sager Corporate Offices 18005 Cortney Court, City of Industry, California 91748 Tel: 626.964.8682, Fax: 626.964.2381 Hours: Monday-Friday 7:30a.m. - 6p.m.(PST) American Express, VISA, MasterCard & Discover Credit Cards Accepted - No Surcharge. Cashiers Checks Welcomed. ©2017 by Midern Computer, Inc. All rights reserved. Ultrabook, Celeron, Celeron Inside, Core Inside, Intel, Intel Logo, Intel Atom, Intel Atom Inside, Intel Core, Intel Inside, Intel Inside Logo, Intel vPro, Itanium, Itanium Inside, Pentium, Pentium Inside, vPro Inside, Xeon, Xeon Phi, and Xeon Inside are trademarks of Intel Corporation in the U.S. and/or other countries. All company and/or product names mentioned herein are trademarks and/or registered trademarks of their respective companies. Prices and specifications are subject to change without notice. Opened software and shipping charges are non-refundable. 30-Day money back guarantee does not include freight or shipping and handling charge. *Free UPS Ground Shipping valid to contiguous US order only.



NP9172 Notebook \$2,399

FREE UPS GROUND SHIPPING*

- Windows 10 Home
- 7th Generation Intel® Core™ i7-7700K Processor
- 17.3" Full HD IPS Matte Display (1920x1080) w/NVIDIA® G-SYNC Technology
- NVIDIA® GeForce™ GTX 1070 8GB GPU
- Opt. NVIDIA® GeForce™ GTX 1060 or 1080 GPU
- 16GB Dual Channel DDR4-2400MHz Memory
- 500GB WD Blue M.2 SSD + 1TB 7200RPM Hard Drive
- Full Color Programmable backlight Keyboard
- Killer DoubleShot™ Pro with Smart Teaming (1000Mbps LAN + Killer Wireless-AC 1535)
- Thunderbolt Gen3 & USB 3.1 Type-C Ports
- Built-in 2.0M FHD Camera & Fingerprint Reader
- Headphone output w/ESS SABRE HIFI Audio DAC



NP9152 Notebook \$1,899

FREE UPS GROUND SHIPPING*

- Windows 10 Home
- 7th Generation Intel® Core™ i7-7700 Processor
- 15.6" Full HD IPS Matte Display (1920x1080) w/NVIDIA® G-SYNC Technology
- Opt. 15.6" FHD, 120Hz 5ms Matte Display with G-SYNC
- NVIDIA® GeForce™ GTX 1060 6GB GPU
- Optional NVIDIA® GeForce™ GTX 1070 GPU
- 16GB Dual Channel DDR4-2400MHz Memory
- 250GB WD Blue M.2 SSD + 1TB 7200RPM Hard Drive
- Full Color Programmable backlight Keyboard
- Killer DoubleShot™ Pro with Smart Teaming (1000Mbps LAN + Killer Wireless-AC 1535)
- Thunderbolt Gen3 & USB 3.1 Type-C Port
- Headphone output w/ESS SABRE HIFI Audio DAC



NP8177 Notebook \$1,799

FREE UPS GROUND SHIPPING*

- Windows 10 Home
- 7th Generation Intel® Core™ i7-7700HQ Processor
- Opt. unlocked Intel® Core™ i7-7820HK Processor
- 17.3" Full HD IPS Matte Display (1920x1080) w/NVIDIA® G-SYNC Technology
- NVIDIA® GeForce™ GTX 1070 8GB GPU
- 16GB Dual Channel DDR4-2400MHz Memory
- 250GB WD Blue M.2 SSD + 1TB 7200RPM Hard Drive
- Full Color Programmable backlight Keyboard
- Intel® Dual Band Wireless-AC 8265 + Bluetooth
- Built-in 2.0M FHD Camera & Fingerprint Reader
- Headphone output w/ESS SABRE HIFI Audio DAC
- Slim design with only 1.18 inch thin



NP8157 Notebook \$1,699

After \$50 Instant Savings

- Windows 10 Home
- 7th Generation Intel® Core™ i7-7700HQ Processor
- Opt. Intel® Core™ i7-7820HK Processor
- 15.6" Full HD IPS Matte Display (1920x1080) w/NVIDIA® G-SYNC Technology
- Opt. 15.6" 4K QFHD or FHD 120Hz 5ms, Matte Display with G-SYNC
- NVIDIA® GeForce™ GTX 1070 8GB GPU
- 16GB Dual Channel DDR4-2400MHz Memory
- 250GB WD Blue M.2 SSD + 1TB 7200RPM Hard Drive
- Full Color Programmable backlight Keyboard
- Intel® Dual Band Wireless-AC 8265 + Bluetooth
- Built-in 2.0M FHD Camera & Fingerprint Reader
- Headphone output w/ESS SABRE HIFI Audio DAC



NP8176 Notebook \$1,549

FREE UPS GROUND SHIPPING*

- Windows 10 Home
- 7th Generation Intel® Core™ i7-7700HQ Processor
- 17.3" Full HD IPS Matte Display (1920x1080) w/NVIDIA® G-SYNC Technology
- NVIDIA® GeForce™ GTX 1060 6GB GPU
- 16GB Dual Channel DDR4-2400MHz Memory
- 250GB WD Blue M.2 SSD + 1TB 7200RPM Hard Drive
- Full Color Programmable backlight Keyboard
- Intel® Dual Band Wireless-AC 8265 + Bluetooth
- Built-in 2.0M FHD Camera & Fingerprint Reader
- Sound Blaster® X-Fi™ MB5 Sound System
- Slim design with only 1.18 inch thin



NP8156 Notebook \$1,499

FREE UPS GROUND SHIPPING*

- Windows 10 Home
- 7th Generation Intel® Core™ i7-7700HQ Processor
- 15.6" Full HD IPS Matte Display (1920x1080) w/NVIDIA® G-SYNC Technology
- NVIDIA® GeForce™ GTX 1060 6GB GPU
- 16GB Dual Channel DDR4-2400MHz Memory
- 250GB WD Blue M.2 SSD + 1TB 7200RPM Hard Drive
- Full Color Programmable backlight Keyboard
- Intel® Dual Band Wireless-AC 8265 + Bluetooth
- Built-in 2.0M FHD Camera & Fingerprint Reader
- Sound Blaster® X-Fi™ MB5 Sound System
- Slim design with only 0.98 inch thin



NP7850 Notebook \$1,299

After \$100 Instant Savings

- Windows 10 Home
- 7th Generation Intel® Core™ i7-7700HQ Processor
- 15.6" Full HD IPS Matte Display (1920x1080)
- NVIDIA® GeForce™ GTX 1060 6GB GPU
- 16GB Dual Channel DDR4-2400MHz Memory
- 250GB WD Blue M.2 SSD + 1TB 7200RPM Hard Drive
- Full Color Programmable backlight Keyboard
- Intel® Dual Band Wireless-AC 8265 + Bluetooth
- Built-in 2.0M FHD Camera & Fingerprint Reader
- Sound Blaster® Cinema 3 Sound System



NP5855 Notebook \$799

After \$100 Instant Savings

- Windows 10 Home
- 7th Generation Intel® Core™ i7-7700HQ Processor
- 15.6" Full HD Matte Display (1920x1080)
- NVIDIA® GeForce™ GTX 1050 2GB GPU
- 8GB DDR4-2400MHz Memory
- 1TB 5400RPM Hard Drive
- Single Color White-LED backlight Keyboard
- Intel® Dual Band Wireless-AC 3165 + Bluetooth
- Built-in 2.0M FHD Camera
- Sound Blaster® Cinema 3 Sound System
- Slim design with only 0.98 inch thin

Customize and Instant Pricing at: SAGERNOTEBOOK.COM

ASUS ROG CROSSHAIR VI HERO



Old faithful AM4 motherboard made manifest

ASUS IS A BEHEMOTH of a company, split into different divisions dealing with graphics, peripherals, monitors, mobile devices, and everything else, with divisions upon divisions upon divisions, each with the aim of producing and maintaining products aimed at its own target audience. Take the motherboard division, for example. Inside this monumental substructure, you'll find Republic of Gamers, TUF, WorkStation, and the Pro series of mobo teams. Each team working independently of one another, both in motherboard design and BIOS/UEFI development.

Why do we bring this up? Well, it's to do with motherboard choice. Not all Asus motherboards are born equal. This Crosshair VI, plied with the latest BIOS update, is a phenomenal piece of gear, more than capable of hitting higher than 3,000MT/s memory overlocks, and one of the easiest plug-and-play kits we've seen. It's nothing short of awe-inspiring.

For anyone accustomed to overclocking on Z77 Asus motherboards and above, very little has changed, with all the same options readily available for those people who like to delve into the Digi+ Power Control settings within the BIOS.

Overall performance was impressive. Memory latency was the lowest we

observed, and computational performance was well within margin of error. We did see some rather impressive low and peak power draw overall, but still couldn't push our Ryzen 7 1800X sample any higher than the 4.0GHz across all eight cores that we've seen elsewhere. What really impressed, however, was the undervolting. We managed to net an impressive 1.2V on the V Core, dropping temperatures by 10 degrees in the process.

The real sweet spot of the Crosshair VI, though, lies in its vast arsenal of rear I/O. We're talking two full banks of four USB 3.0 ports, one bank of USB 2.0 ports, one USB 3.1 type A, and one USB 3.1 Type C, alongside a BIOS reset switch, Intel Gigabit Ethernet, and 5.1 audio, with optical out. Couple that with the vast array of SATA and M.2 support buried on board, and it's a genuine force to be reckoned with.

It does come in at a pretty hefty price premium of \$255 overall, but for what you're getting, it's honestly one of the best—if not the best—Ryzen motherboards out there to date. Cooling support is ample, overclocking prowess pretty prominent (more applying to higher-end memory kits), and the BIOS that Asus's ROG division is pumping out is improving memory support by leaps and bounds.

SPECIFICATIONS

Chipset/Socket	X370/AM4
Form Factor	ATX
Memory Support	64GB @ 3,200
M.2/U.2 Support	1x M.2 PCIe x4
SATA Support	8x SATA 6Gb/s
Max PCIe GPU Support	x8/x8
Rear I/O	1x USB 3.1 Type C, 1x USB 3.1 Type A, 8x USB 3.0, 4x USB 2.0, 1x RJ45 Ethernet, 1x optical S/PDIF out, 5.1 audio, 1x M.2 Wi-Fi slot, clear CMOS button, USB BIOS flashback button

VERDICT

9

Asus ROG Crosshair VI Hero

■ **IRON SIGHTS** Humongous I/O; dependable; works well

with memory.

■ **OFF TARGET** Price is a touch high.

\$255, www.asus.com

GIGABYTE GA-AB350- GAMING 3



A sample of AMD's budget spec

AT LAST, WE'VE WITNESSED AMD's second chipset, the B350—team red's answer to Intel's H270. But is it strong enough to withstand the full brunt of Ryzen's notorious bugs, while not being at the top of AMD's pile of enthusiast boards?

Gigabyte's AB350-Gaming 3 is the first board we've tested under this new chipset, it was certainly an adventure. By default, the AB350 should be overclockable, but in our tests, we just couldn't get that spark to ignite, no matter what settings we tinkered with in the rather limited OC BIOS. Memory support was also lacking. Even with the latest BIOS, our Corsair Vengeance kit was limited to 2,133MT/s. Of course, we could put this down to BIOS bugs, but we're now two months into the Ryzen release, with Ryzen 5 chips just on launch, and 3 not far behind. So why aren't these more budget-centric AM4 offerings getting as much love as the top-end X370 ones from the same company? Your guess is as good as ours.

For each board we test, we check whether our memory kit will operate at 3,000MT/s, then clock down to 2,666 for the rest of our benchmarks. The idea is to bring the spec more in line with what an average Ryzen system should look like. On the Gaming 3, we couldn't do that, and it shows, with scores plummeting in X265, Cinebench

R15, and Fry Render, and memory latency some of the highest we've seen.

As for aesthetics, there's not a lot to talk about. Gigabyte has stuck with the familiar red, black, and silver color scheme we saw with the Z170 Intel series boards, with a chunky black heatsink near the rear I/O, and that's about it. LED lighting is on board, with one single strip on the right. The feature set is, well, acceptable. There are four SATA 3 ports, two PCIe x16 ports (bear in mind CrossFire and SLI are disabled on B350), and a single M.2 port for a full x4 PCIe SSD, if super-slick storage is your jam. Rear I/O is the absolute minimum, too, with hints of HDMI and DVI-I compatible processors coming down the line soon.

What's the biggest positive we can draw from this? The price. For \$110, it's hard to argue with how cheap this is, and how easily you can jump on to the platform. Undoubtedly, over time, and with enough BIOS updates, you'll probably see those supported memory frequencies rise. And hopefully more expansive BIOS options for those looking to tweak their chips a touch higher. That said, for now, if you're looking for the best board to overclock on, you should go for one of the X370s—Asus's Crosshair VI Hero or MSI's X370 Gaming Pro Carbon, in particular, are swell clockers.

SPECIFICATIONS

Chipset/Socket	B350/AM4
Form Factor	ATX
Memory Support	64GB @ 3,200 (plus 2,667 CPU dependent)
M.2/U.2 Support	1x M.2 PCIe x4
SATA Support	6x SATA 6Gb/s
Max PCIe GPU Support	x16 (CrossFire/SLI disabled)
Rear I/O	2x USB 3.1 Type A, 4x USB 3.0, 1x USB 2.0, 1x RJ45 Ethernet, 1x optical S/PDIF out, 5.1 audio, 1x PS/2 combi port, 1x DVI-D, 1x HDMI

VERDICT



Gigabyte GA-AB350-Gaming 3

BUDGET KING Price; OK feature set; simple styling.

BARGAIN BIN Poor stock performance.
\$110, www.gigabyte.com

GIGABYTE GA-AX370- GAMING 5



Sleek, simple, classy

GIGABYTE IS THE KING of value when it comes to motherboards. Its crisp, sharp PCBs provide almost everything you could want, at a price that makes its competitors weep. It won our Z170 mobo roundup with its Gaming 5, and would have undoubtedly grabbed a victory among Z270 boards, too, if we'd delved into that minor update. Can the same be said for AMD's latest platform?

Well, it's off to a good start. The design is undeniably clean: The satin white finish on the heatsinks and rear I/O shield, coupled with the brushed aluminum and black PCB certainly make it look the part. The LED lighting is a little less subtle than we'd like, dotted around the VRMs near the socket, the onboard audio, PCIe slots, and DRAM. But the biggest block is the oddly transparent, jagged strip running down toward the neatly placed U.2 and SATA ports. Fortunately, you can remove it, or design your own piece of shiny acrylic to cover the LED-touting side. Or just switch it off. Yes, do that—switch off those RGB rainbows, for humanity's sake.

Alas, when it comes to performance, the Gaming 5 took a little tweaking. The default BIOS failed to support our 3,000MT/s overclock, forcing us to clock down to 2,666 until we got the new AGESA BIOS later on. That aside, it scores fairly well in all our performance tests, being within 1

percent of the Asus Crosshair VI Hero in almost everything—except a slightly higher power draw. What really impressed was the phenomenally tight memory latency. AIDA64 saw latencies as low as 83ns, outperforming all the other boards on test.

We also cranked up the overclock to 4GHz, as is the norm for our Ryzen 7 1800X. But when it came to undervolting, the Gaming 5 came undone. This was the first board on which we managed to kill a chip in this test. Admittedly, our mistake—during our undervolt testing, instead of placing the chip under 1.18V of V Core, we put it under 1.8V. Before proceeding to boot into Windows and benchmark the crap out of it. It was only when we heard the fan ramp up, and noticed the clock speeds registering at 1GHz, that we realized what had occurred. We switched off the machine and returned to stock voltages in BIOS. Alas, one restart later, and poof—no more display. Yes, it was an error on our part, but it could have been prevented by overvoltage protection in the BIOS, a feature included in Asus's Crosshair VI Hero and MSI's XPower Gaming Titanium.

Ultimately, the Gaming 5 still offers great value, with solid stock performance, and looks that could kill. But if you're tweaking those sweet overclocks, keep an eye on the voltage inputs, just in case.

SPECIFICATIONS

Chipset/Socket	X370/AM4
Form Factor	ATX
Memory Support	64GB @ 3,200 [plus 2,667 CPU dependent]
M.2/U.2 Support	1x M.2, 1x U.2
SATA Support	2x SATA Express, 8x SATA 6Gb/s
Max PCIe GPU Support	x8/x8
Rear I/O	1x USB 3.1 Type C, 3x USB 3.1 Type A, 6x USB 3.0, 2x RJ45 Ethernet, 1x optical S/PDIF out, 5.1 audio, 1x PS/2 combi port, 1x HDMI

VERDICT



Gigabyte GA-AX370-Gaming 5

ELECTRIFYING Solid performance; great value for money; stunning looks.

FRYING Lacks overvolt protection; that LED strip; early BIOS niggles.

\$195, www.gigabyte.com

MSI X370 GAMING PRO CARBON



Carbon fiber all the things

GIGABYTE'S GAMING 5 series has generally always been the value king, but it might need to rethink its game plan with the likes of MSI dropping this sweet little number on to the AMD playing field. It may not have as clean a look as Gigabyte's mighty Aorus lineup, but it's hard to deny that the connectivity is there. Sort of.

Well, OK, so you lose out on a few banks of SATA 3, there's no U.2, and it's still prone to MSI's haphazard butchery of the rear I/O, but all in all, it's a well specced board for anyone looking to build a fairly entry-level Ryzen rig, even featuring DVI-I for those future APUs that might come out soon (seriously, we don't know). All joking aside, couple this with a Ryzen 5 1600, and you're looking at a six-core, 12-thread, DDR4-touting overclockable workstation base for a little under \$400.

So, aesthetics. Yeah, it's covered in a carbon finish. We're not sure why. Honestly, do motherboards benefit from being lighter? (Spoiler: It's not carbon fiber.) It's a controversial checkered finish that you'll either love or hate. On the other hand, the black finish across the board is swell, and the RGB lighting is easy to configure to any color you want in MSI's desktop app.

Onboard audio across the brands right now is pretty solid. Not quite up to

the level of DAC and HRA, but for anyone simply wanting to plug and play, you're unlikely to find much difference between motherboards. The Nahimic audio suite included with MSI's lineup since the Z170 series, on the other hand, is a force to be reckoned with. For those familiar with THX's Crystalizer software, way back in the days of Windows 7, think of this as that on steroids.

On to performance, and the Gaming Pro Carbon actually outshone its XPower cousin in the X265 benchmark, Cinebench, and even Fry Render, by around 1 percent in most cases. Memory latency was fairly middle ground, with power draw being our overall winner, both under load and idling. We also managed a swift 3,000MT/s overclock on our 16GB Corsair Vengeance LPX kit as well—again, with the latest BIOS update. We can't stress enough how important it is that you update your BIOS if you're already using—or thinking about jumping on to—the AM4 platform.

Ultimately, MSI's X370 Gaming Pro Carbon is one of the best value boards out there. If you're looking for all the connectivity and features that Ryzen has to offer in an affordable package, and aren't too bothered about appearances, the Pro Carbon is definitely the board for you.

SPECIFICATIONS

Chipset/Socket	X370/AM4
Form Factor	ATX
Memory Support	64GB @ 3,200+
M.2/U.2 Support	2x M.2
SATA Support	6x SATA 6Gb/s
Max PCIe GPU Support	x8/x8
Rear I/O	1x USB 3.1 Type C, 1x USB 3.1 Type A, 4x USB 3.0, 2x USB 2.0, RJ45 Ethernet, 1x optical S/PDIF out, 5.1 audio, 1x DVI-D, 1x HDMI



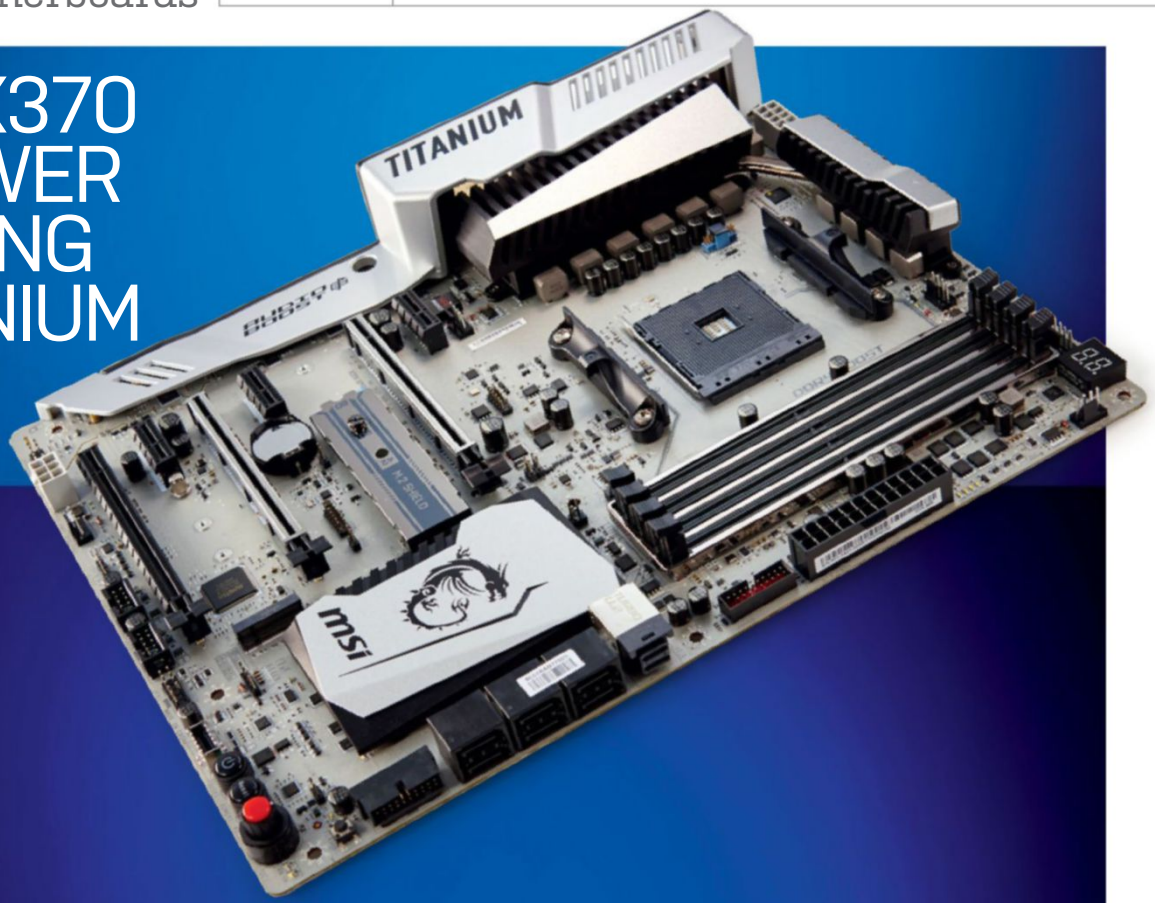
MSI X370 Gaming Pro Carbon

❑ SUPERLEGGERA Dependable feature set; it's black; RGB lighting; solid performance; staggering price.

❑ LUMP OF COAL Carbon finish is controversial; needs more rear I/O.

\$180, www.msi.com

MSI X370 XPOWER GAMING TITANIUM



Hints at an integrated GPU future

IT'S HARD TO IGNORE the rivalries that exist in computing. Dogmatic factions stand resolute against logic, faithfully defending their torchlit companies online. Flailing argument after argument attempts in vain to derail some well-conceived post. It's an age-old fight. Red versus blue, Intel versus AMD, Microsoft versus Apple. And no more does it exist than between Asus and MSI. More blood has been shed between these two companies than most people realize.

They're the industry titans, continually goading one another to even headier heights than the last, and nowhere is this more apparent than with MSI's X370 XPower Gaming Titanium, the pinnacle of what MSI has to muster on AMD's new platform.

The crisp silver board is a far cry from yesteryear's budget offerings we used to recommend with AMD-specced systems. Platinum DDR and PCIe surrounds, reinforced to prevent strain on the sockets and hardware. A blackened M.2 heat shield, ready to absorb any additional heat spewed out by thermal-happy M.2 PCIe SSDs. The inclusion of Intel's U.2 connection standard next to the bank of SATA 3 ports. All of it pushes the price and feature set of this board higher than any other our list.

Admittedly, the Titanium does fall a little flatter in rear I/O support compared to the

Crosshair VI Hero. With three USB 3.1 type A ports, one USB 3.1 type C, two USB 2.0, and the usual 5.1 audio and Intel Gigabit Ethernet, it doesn't quite compete with its Pegasus-inspired counterpart. However, it's the inclusion of two ports in particular that caught our eye: A DisplayPort 1.2 and HDMI 2.0 port are nestled next to a right-angled USB 2.0 diagnostic hub, indicating that processors with integrated graphics are on their way.

Performance is what you'd expect. There's very little variance between any of the motherboards here. One notable exception is the idle power draw, topping out at 61W, making it one of the highest. Additionally, X265 took a bit of a hit, compared to almost all of the other boards we tested—intriguing, because the memory was registering accurately at 2,666. Speaking of memory, although latencies still remain higher than on the Intel platform, thanks to the new AGESA code handed out by AMD, and some succulent BIOS updates, we've seen higher frequency memory kits work well across most of the X370 lineup, the XPower Gaming Titanium being no exception.

Ultimately, if you're after a board with glitz and glam, the XPower X370 Gaming Titanium has it in spades.

SPECIFICATIONS

Chipset/Socket	X370/AM4
Form Factor	ATX
Memory Support	64GB @ 3,200+
M.2/U.2 Support	2x M.2
SATA Support	6x SATA 6Gb/s
Max PCIe GPU Support	x8/x8
Rear I/O	1x USB 3.1 Type C, 1x USB 3.1 Type A, 4x USB 3.0, 3x USB 2.0, 1x Intel Gigabit Ethernet, 1x optical S/PDIF out, 5.1 audio, 1x PS/2 combi port, BIOS reset, 1x DisplayPort, 1x HDMI

VERDICT

8

MSI X370 XPower Gaming Titanium

UNLIMITED POWAH Stunning aesthetic; well equipped; hints at APU future; solid performance; impressive audio solution.

KINDA SOUR Pricey; overclocking seems a little mute with Ryzen.

\$300, www.msi.com



The home of technology

techradar.com

HOW WE TESTED

WE KNEW THIS SUPERTEST was going to be a turbulent one, because of how brand new architectures tend to operate, so we cast our net wide from the start, but that didn't prevent a few headaches along the way.

Taking a cross section from MSI, Asus, and Gigabyte, we originally chose nine motherboards, both X370 and B350, before whittling the list down to five. Four boards didn't make it through—three due to testing failures, and one simply didn't arrive in time.

Notable mentions: the Asus Prime X370-Pro and the MSI B350 Tomahawk. We spoke briefly earlier about how each section of Asus's massive structure is broken down into individual teams, with each part working autonomously—unfortunately, not all parts are equal. ROG vastly outshines the Pro team when it comes to BIOS stability—in fact, we bricked two Prime X370-Pros. One during the initial Ryzen launch via a BIOS update, and the replacement died following a similar event (although it made it past the update,

failing to boot Windows). With the Tomahawk, we didn't even make it to BIOS, unfortunately, regardless of what configuration we used. That's not to say these motherboards are a no-go area, just that if you're thinking of buying cheap, yet still want to push the boundaries when it comes to running above stock 2,133MT/s or processor overlocks, it might be worth holding off for a month or two longer.

For the time being, it seems Ryzen's top-end chipset has had most of the bugs ironed out, at least for the more premium lines associated with each brand. However, the budget-oriented options may need a little extra time.

Our testing setup consisted of an AMD Ryzen 7 1800X, 16GB (2x 8GB) of Corsair Vengeance LPX DDR4 capable of clocking up to 3,000MT/s (provided by AMD), an Nvidia GeForce GTX 1080, a Samsung 850 Evo 250GB OS drive, with a clean install of Windows 10, plus an ADATA SX8000 256GB PCIe SSD to test out the M.2 ports, and you can see how each board performed below.

BENCHMARKS

	Asus ROG Crosshair VI Hero	Gigabyte GA-AB350-Gaming 3	Gigabyte GA-AX370-Gaming 5	MSI X370 Gaming Pro Carbon	MSI X370 XPower Gaming Titanium
X265 (fps)	27.97	26.33	27.96	27.98	26.98
Cinebench R15 (Index)	1,616	1,585	1,614	1,622	1,615
Fry Render (m:s)	2:38	2:58	2:38	2:38	2:41
AIDA 64 Memory Latency (ns)	89	100	83	90	93
CrystalDisk Sequential Read SATA (MB/s)	550	550	550	550	551
CrystalDisk Sequential Write SATA (MB/s)	525	528	514	523	495
CrystalDisk Sequential Read M.2 (MB/s)	2,339	2,349	2,430	2,428	2,404
CrystalDisk Sequential Write M.2 (MB/s)	1,158	956	957	1,200	1,004
Power Draw Idle (W)	51	55	62	56	61
Power Draw Peak (W)	164	146	197	147	166
Far Cry Primal (Avg fps)	42	41	42	42	42
3DMark Fire Strike Extreme (Index)	9,718	9,755	9,709	9,647	9,706
Max Memory OC (MT/s)	3,000	2,133	3,000	3,000	3,000

Best scores are in bold. All game benchmarks tested at 1440p, with AA ramped up, at the highest possible graphics preset.

AND THE WINNER IS...



MSI X370 Gaming Pro Carbon

WHAT A ROLLER COASTER this has been. At the start, we knew it wasn't going to be easy—and we were right. Three motherboards, one chip, and this reviewer's soul have been claimed by the beast of bedlam that is Ryzen's monstrous new AM4 platform.

On paper, Ryzen and its new chipsets are sound. Logical even. After all, the vast majority of I/O included on modern mobos goes untouched by mainstream users. And despite Ryzen's seemingly high-end, professional heritage, its price point puts it in the realm of the average joe. The rumored X399 platform, hopefully coming soon, should be a re-envisioned HEDT variant of Ryzen, with a far more expansive chipset (hopefully mostly on the processor), but for now, this is what we have to play with.

AM4 is still in its infancy, and so are the chips. For the vets out there, who remember the early days of Hyper-Threading, and even Nehalem's launch, the teething problems will come as no surprise. So, don't let this put you off investing in the Ryzen platform, because the bugs are being ironed out at a phenomenal rate. It seems every new BIOS update improves performance and stability at a rate of knots.

So, on to the motherboards. Two of the boards in this issue's supertest particularly

impressed us: Asus's Crosshair VI Hero and MSI's X370 Gaming Pro Carbon. The Hero was the first board we got hands-on with during our Ryzen testing, and it's not difficult to understand why AMD chose to ship this one out to us. Its ease of use, support for high-end memory from the get-go, and in-depth UEFI BIOS made it a breeze for most reviewers not wanting to dig more than skin deep into AMD's latest platform.

However, it's the Gaming Pro Carbon that really stole the show. Coming in at \$80 less than the Crosshair VI Hero, and packing that vital core performance, its stability, memory support, and overall feature set are more than enough for anyone looking to sate their eight-core desires. That carbon finish? Well, it's certainly different. Let's call it that. OK, MSI, truthfully: We don't like this finish. Keep it black, have a brushed

aluminum styling on it, clean it up, keep the lines straight and the MSI logo sharp, and you'd be on to a classic. But the checkered carbon look? Not for us.

But back to the biggest positive of them all: the price. There's \$80 difference between the Crosshair VI and this beauty. With that saving, you could upgrade from a six-core Ryzen 5 1600X to an eight-core Ryzen 7 1700. Whack that clock speed up to 4GHz, and you'd easily be rolling above the 1800X, and within spitting distance of Intel's Core i7-6950X.

Ultimately, AMD's AM4 platform, for the time being at least, is still a touch messy. Go with boards you know you can trust, search around to find the best deals, and don't get scalped. And if you're really keen to become an early adopter, make sure you stick to the premium lines from mobo manufacturers, otherwise you're likely to get burned. ⚡



Its stability, memory support, and overall feature set are more than enough for anyone looking to sate their eight-core desires.



WINDOWS 10 CREATORS UPDATE EXPLAINED

The second major update to Windows 10 has just dropped. Here's all you need to know. *By Matt Hanson*



WHEN WINDOWS 10 LAUNCHED in July 2015, it was met with acclaim—and also a fair amount of relief—because it was a marked improvement over its predecessor, Windows 8. However, it still wasn't a perfect operating system, and Microsoft appears to have acknowledged this by releasing two major updates for it: The first, the Anniversary Update, hit our PCs last year, and now the Creators Update is currently rolling out to PCs around the world as you read this.

Windows updates are rarely worth getting excited about, but the number of tweaks, fixes, and new features that Microsoft has promised with this release makes it worth downloading. As the name suggests, Microsoft has focused on bolstering the creative aspects of Windows 10. However, if you have less creative juice flowing through you than a heap of rocks does, the good news is that Microsoft has a rather

liberal interpretation of what it means to be a "Creator,"

So, it's not just people who like to put stylus to Surface and create digital art—it also applies to people who play games and like to stream and share their gameplay with friends and strangers across the Internet. Of course, there is also the usual array of less glamorous (and arguably more essential) security and usability tweaks to make Windows 10 an all-around better piece of software to use. In this article, we're looking at how you can download and install the Creators Update, why you would want to, what cool new features you'll be getting, and how to use them. Windows 10 still isn't perfect, but with major free updates such as the Creators Update, it shows that Microsoft is committed to evolving and improving its operating system, which is definitely something worth celebrating.

GET THE CREATORS UPDATE

The Windows 10 Creators Update is a free download for every Windows 10 user. The good news is that this means at some point in the future, your PC will let you know that the update is ready to be downloaded and installed. All you need to do is make sure your work (or any game progress) is saved, then let Windows Update do its thing.

However, to stop the millions of Windows 10 users all trying to download the rather hefty update all at once, and potentially breaking part of the Internet, Microsoft is rolling out the update to PCs around the world in waves, and it's been a bit coy about how long this rollout process will take.

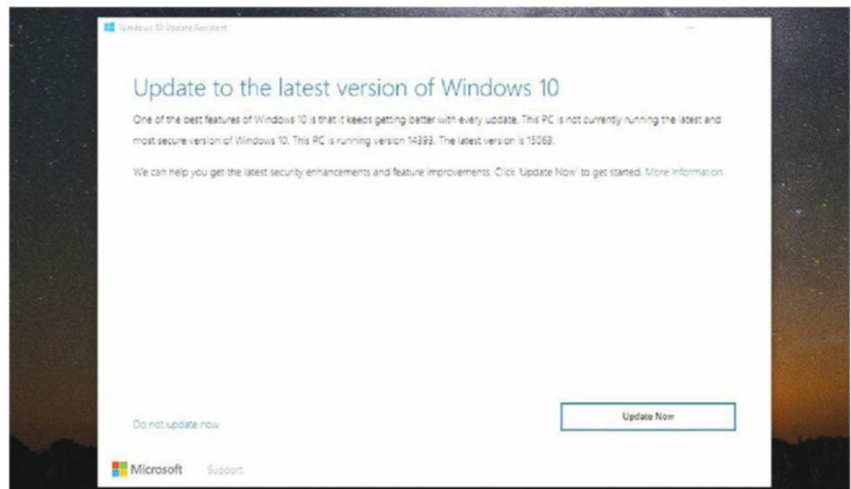
So, you might get the Creators Update in the next few days, or you may have to wait weeks—even months—before it appears in Windows Update.

However, like the Good News Fairy that we are (think the Tooth Fairy, but with a beer belly and faded *Half Life 2* T-shirt), we have more glad tidings: There's a way to manually update to the Creators Update yourself, so you don't have to wait for the rollout.

To manually download Windows 10 Creators Update, head to the Windows 10 Update Assistant web page (www.microsoft.com/en-us/software-download/windows10), then click "Update now."

The tool downloads, then checks for the latest version of Windows 10, which includes the Creators Update.

Once downloaded, run it, then select "Update Now." The tool does the rest for



Use the Windows 10 Update Assistant to manually download and install the update.

you. Your PC restarts a few times—so make sure you save your work first—and then your PC is updated with the Creators Update, while all your files and settings remain where they were.

That website also allows you to download an ISO image, which you can then use to update your current installation of Windows 10, or perform a clean install with the Creators Update.

WHAT'S NEW?

With the Creators Update installed, what new features await you? Well, one of the most exciting additions is a new program

called 3D Paint. We know what you're thinking: Who cares about a new version of Microsoft Paint? And who still cares about 3D? We were as surprised as you are, after meeting Microsoft to see Creators Update before it launched, to come away so impressed by this new app.

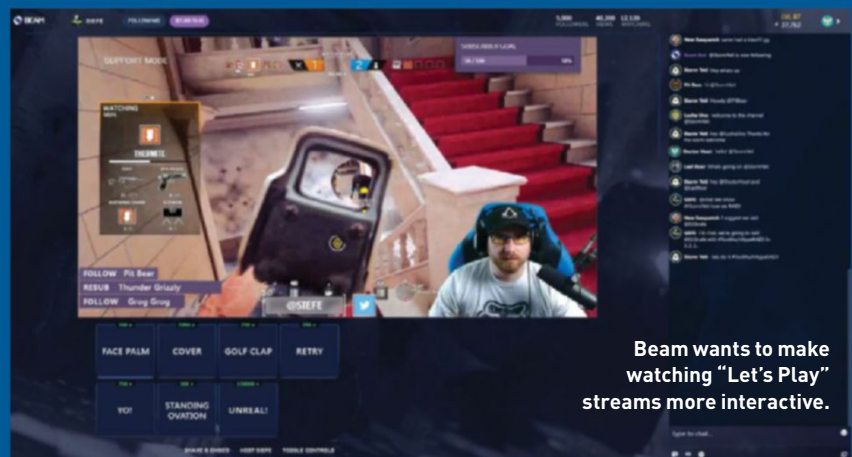
3D Paint, like its 2D counterpart (which remains its own separate program), grants simple tools for people to create their own artwork. What's particularly impressive about 3D Paint is that the concept of creating models in a 3D space can be quite complicated, but 3D Paint makes the process incredibly simple, with the tools

BEAM: TOOLS FOR BROADCASTING

Video game streaming is incredibly popular, with Twitch gaining 100 million monthly unique users watching over 2 million monthly streamers since it launched in 2011, with around 241 billion minutes of content being broadcast, so it's little wonder that Microsoft is so keen to get involved. It has done this by acquiring the Beam service last year, and integrating it into Windows 10's Creators Update and the Xbox One. Classic Microsoft.

Of course, with the success of Twitch and other established services, Microsoft has an uphill struggle to convince people to move from their preferred service to Beam. However, it has a few tricks up its sleeve.

For a start, it has a focus on super low latency, something Microsoft is describing as the "Beam Faster than Light SDK," which allows for broadcasting with virtually no latency. By having almost no perceptible pause between the action in the game the broadcaster is playing and what the audience sees, it makes conversations between the

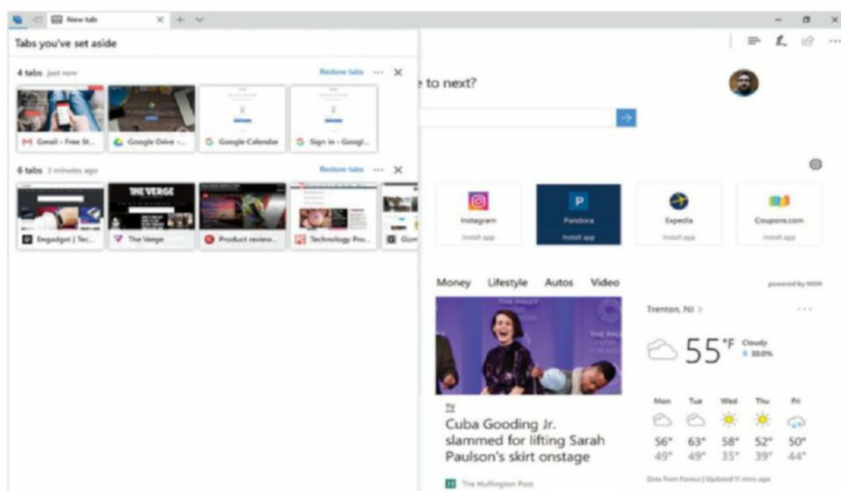


broadcaster and the audience even better. You could now tell a broadcaster to look out behind them, and they'd react, rather than telling them, only to find out three seconds later that they are already dead.

Microsoft also plans for Beam to have a full suite of interactive elements for its streams. These range from simple soundboard apps (which allow viewers to trigger specific sound effects) that can

be applied to any game, through to more complex interactive elements, introduced as part of Microsoft's "Interactive 2.0" initiative, launched at GDC earlier this year.

When implemented into a game, these features (combined with the low latency) will enable viewers to be almost as involved in the action as the streamers themselves, "blurring the lines between playing and watching," as Microsoft puts it.



Edge has been given an overhaul, and using tabs is now better than ever.

it offers appearing very straightforward at first, but powerful enough to create some impressive 3D works once you're comfortable using them.

These creations can be exported and viewed on normal PCs, or added to VR and AR applications to be viewed in 3D. Plus, if you have a 3D printer hooked up to your PC, it's incredibly easy to print off your creations. It's difficult to explain in writing, but trust us: Load up 3D Paint and have a play around—it may just be your new favorite application.

Microsoft's renewed love of 3D extends beyond 3D Paint to PowerPoint (for 3D models and 3D animations, to make presentations slightly less dull), and the default Edge web browser, which now supports 3D content, and plays nicely with 3D files exported from various programs, such as *Minecraft*, SketchUp, and, of course, 3D Paint.

While 3D displays are now out of vogue, mixed reality—just like virtual reality and augmented reality—is the hot new thing, and it is these technologies that have rekindled Microsoft's 3D passion. Under the name "Windows Mixed Reality," which used to be called "Windows Holographic," this is a mixed reality platform built by Microsoft on the Windows 10 API, and it is now heavily integrated into the Windows 10 Creators Update.

It means that you can create your own 3D model (or simply download an existing one), and then easily place it into a real or virtual world using a VR or AR headset. While Microsoft's own AR headset HoloLens is a pricey proposition, Microsoft also announced last year that it is working with a number of headset manufacturers to bring third-party AR and VR headsets to Windows 10 machines. A new app, the Mixed Reality Portal, is included with the Creators Update

to show you exactly what Windows 10 is capable of.

A FOCUS ON GAMES

Microsoft promising that it still cares about PC gaming, while chasing the shiny Xbox bauble, is something that a lot of us have heard many times before. At least with the Creators Update, it seems like Microsoft may be making some positive moves.

In the Windows 10 Settings app, there is a new addition: Gaming. This setting enables you to control many aspects of how Windows 10 handles games. Its most talked-about feature is the new Game Mode option, which helps your PC maintain solid frame rates as you play, while other background tasks and applications run. We go into more detail in the boxout on the right, but you can turn the feature on and off from the Gaming settings page.

The Game DVR settings page enables you to control how you take screenshots and record gameplay videos. While there's a number of programs that enable you to record and share videos, such as Nvidia's ShadowPlay, Microsoft hopes that by baking this functionality into Windows 10, you're more likely to use its offering, especially as it's so easy to configure and begin recording. Microsoft also argues that by using Windows 10 to record your gameplay, rather than third-party software, your PC will have more resources at its disposal, which in turn should give you more consistent and stable frame rates when you play games while recording.

Among the new Game DVR settings is the ability to turn audio recording on (and off), if you want to provide narration, and you can choose the frame rates and video quality from here as well.

You can also set Windows 10's Broadcast settings from this window. In the Creators

Game Mode: Too Good to Be True?

Game Mode is perhaps the feature that generated the most amount of buzz ahead of the launch of the Creators Update. So much so, that Microsoft actually had to downplay expectations, worried that people were getting their hopes up too high.

So, what is Game Mode? It can be toggled from the Game Bar (Windows-G on your keyboard brings this up), and it tells your system to reallocate CPU and GPU hardware resources to prioritize the game at hand when it's the active, full-screen application.

The results, as Microsoft claims, are steadier frame rates than before, notably with games that particularly tax a given system's resources. The idea is that if you're playing a game and recording it in the background—or you have another intensive task running while you play—Game Mode tells Windows 10 to prioritize your game, so you don't see major dips in frame rates. Unlike what some people were hoping—that Game Mode would strip down background apps and tasks while you're playing, to give you hefty boosts to FPS—Microsoft was keen to stress that the results are about stabilizing frame rates, not boosting them. Microsoft also warns that Game Mode brings the most benefit to systems that aren't absolutely optimized for gaming, so if you have an all-powerful rig packed with Titan Xp GPUs, you won't see much difference.

Both Universal Windows Platform (UWP) and Win32 games support Game Mode. Microsoft keeps an internal list of games for this feature, and others related to gaming, which we're told is updated more frequently than Windows itself.

There's no word on how many games—Win32 or UWP—support the feature, but we get the impression that the number is enormous. A select, growing number of games—regardless of whether they're UWP or Win32—will see the feature automatically enabled. Of course, disabling Game Mode on a game is as easy as enabling it.

Paint 3D: Getting Creative

As we mentioned elsewhere, Paint 3D is genuinely one of the most impressive additions included with the Creators Update. When seeing it first-hand, creating three-dimensional pieces of art truly is as simple as Microsoft demonstrated at the update's reveal event last year.

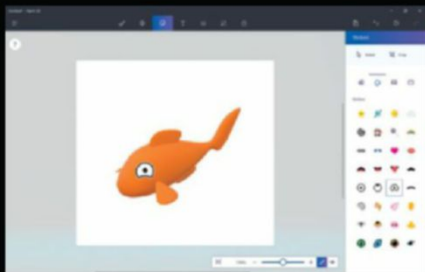
Then again, it's clear that this app has the capacity to allow for quite a bit of complexity, too. Most of that simplicity comes down to how intuitively the app communicates three dimensions in a two-dimensional space. Clever, minimalist use of sliders and other toggles enables you to shift your creation's position on either axis.

Of course, a wide selection of pre-loaded creation templates—such as goldfish—will help newcomers out immensely. Naturally, it wouldn't be Paint without the ability to freehand in 3D, and thus comes the desire to share those custom creations. That's where Remix.com, Microsoft's online portal for sharing these Paint 3D projects, comes into play.

The way in which Paint 3D communicates how to create in a new dimension so easily for the average user, yet offers the depth to please them as they increase in skill, could do a lot of good for the 3D printing scene, as well as VR, and so many other fields further down the road—such as being able to add our creations to games.

Granted, Paint 3D is by no means a professional-grade 3D modeling app—this is purely meant for the vast majority of Windows 10 users who would just like to dabble. You can also export anything created in Paint 3D as 3D-ready FBX or 3MF files for 3D printers.

Regardless, we're already impressed with what Paint 3D can do, and only hope it grows from here. Oh, and don't worry, the old Paint remains untouched.



According to Microsoft's own testing, Edge is the least battery-intensive browser.

Update, Microsoft is looking to seriously up the reach of, and community around, games played on Windows 10 with a new feature called Beam. An acquisition recently made by the firm, Beam is a PC game streaming and broadcasting platform, similar to Twitch, replete with its own streaming network via web browser, converted into a baked-in Game Bar feature (which can be brought up by pressing Windows-G on your keyboard).

Beam's major claim to fame here, though, is that it maintains sub-second latency from the broadcaster's executions in-game to those moments being displayed on your PC screen via stream. In other words, for broadcasters, this reduction in the time between what you're doing in-game and your viewers seeing it makes interacting that much more interesting.

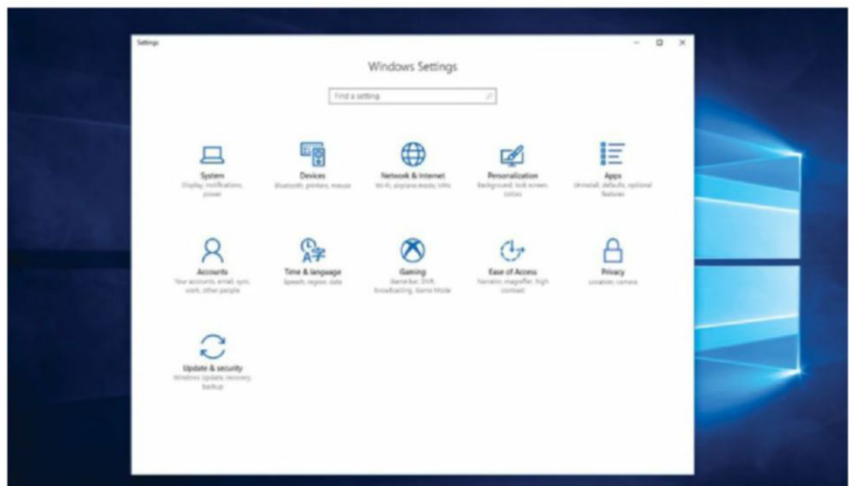
Broadcasting via Beam is made incredibly simple in the Creators Update—all you need to do is open up the Game Bar, click the "Broadcast" icon, then just a few

clicks and toggles after that, and you're broadcasting to Beam viewers worldwide. That's after creating a Beam account, as well as an Xbox Live account, if you haven't already. Once again, this is a sign that, as good as the new features ushered in by the Creators Update are, many of them require you to be fully signed up to Microsoft's ecosystem. If you're not too keen on Microsoft's recent direction, you may not be a huge fan of this. It is, after all, also doubling down on the Windows Store and UWP (Universal Windows Platform) apps for games.

OTHER FEATURES

There's a load of other features included in the Creators Update, and while they aren't as headline-grabbing as Game Mode and mixed reality support, their addition definitely makes Windows 10 a better operating system.

Take Night Light, for example. It's Microsoft's answer to Night Shift on



A new Gaming section has been added to the Windows Settings app.

macOS Sierra, and it is an effective and welcome feature for people who tend to use computers at all hours of the night. It lowers the amount of blue light your PC emits though its display, which can play havoc with your internal clock.

What's even better than the competing solutions is how Night Light enables you to adjust the tone of the color change, in addition to the standard setting of whether the mode kicks in at sunset local time, or activates within set hours.

Microsoft has also thrown a lot of new features at its Edge browser in a bid to make us ditch Chrome and Firefox. As well as the aforementioned support for 3D media, it also includes a genuinely useful tab preview bar that gives you a visual overview of all your currently open tabs, so you can quickly and easily switch between the ones you need. This is a great addition for those of us who usually end a browsing session on the Internet with an unwieldy number of tabs open.

You can also "set tabs aside," which is Microsoft speak for saving open tabs as a collection, which you can then open and restore later.

Edge has often felt a little neglected when it comes to add-ons and extensions, with popular ones on Firefox and Chrome often skipping Microsoft's latest browser. The company is looking to fix that with the Creators Update, by bringing a large number of popular add-ons and extensions to Edge.

Microsoft has also worked hard on making Edge as lightweight as possible, which means that if you're browsing the web on a laptop or tablet, Edge should be less taxing on your device's battery, which should mean more time before your machine dies.

To prove its point, Microsoft has released a battery test video comparison, showing



The Creators Update brings more compatibility with "mixed reality" devices.

the staying power of the three most popular browsers side-by-side, pitting its own Edge offering against Google's Chrome and Mozilla's Firefox.

The test was a simple one: which browser could last the longest while streaming full-screen video from Vimeo. Given that Microsoft is keen for you to see the results, there's no prizes for guessing which browser came out on top—yep, Microsoft Edge.

Edge didn't just, well, edge the test either. Instead, it dominated proceedings, lasting a full 35 percent longer than Google Chrome, and a massive 77 percent longer than Firefox.

While Firefox lasted just 7 hours and 4 minutes before conking out, Chrome managed a full 9 hours and 17 minutes of streaming.

Microsoft's Edge browser, which has been specially tuned for the new Windows 10 Creators Update, just kept on chugging, eventually notching up 12 hours and 31

minutes of streaming time before finally calling it a day.

In terms of fairness, the three browsers were each made to run on identical Surface Book machines, each powered by Intel's 2.4GHz Core i5-6300U processor, 8GB of RAM, and Intel HD Graphics 520 GPU.

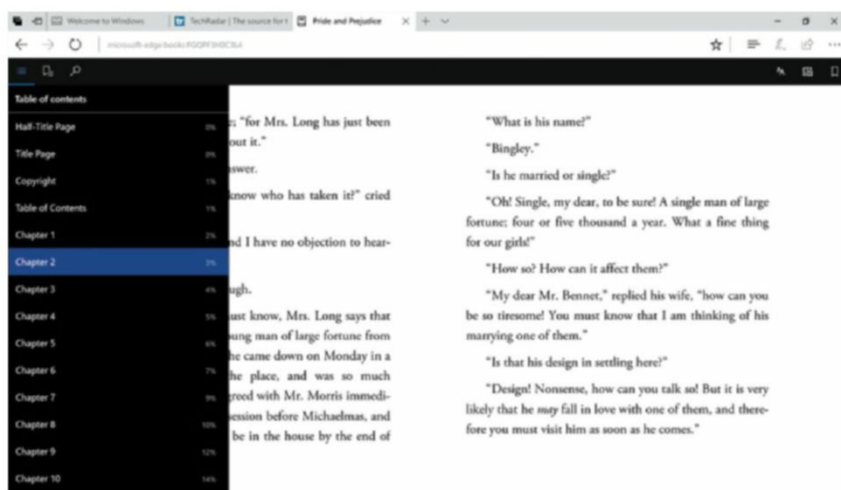
Ensuring further parity, each device was muted, had brightness set to 75 percent, Bluetooth and location disabled, and the Quiet Hours functionality switched on.

To be honest, it's not quite enough for us to make the leap from our trusted browsers to Edge just yet, but it looks like it is definitely going in the right direction.

PRIVACY

As good as Windows 10 is, there were concerns around the default privacy settings it shipped with, with many people worried about the kind of data—and control—to which Microsoft has access. The company has been aware of these criticisms, and it has responded by trying to make it more transparent what kind of data it collects in the Creators Update—as well as making it easier for you to change any privacy setting you don't like.

When you update Windows 10 to the Creators Update, you'll see a screen asking you to choose the privacy settings of your device. The options are for "Location," "Diagnostics," "Relevant Ads," "Speech Recognition," and "Tailored Experiences with Diagnostic Data." Each option has a "Learn more" button that you should click to get a full explanation about what it affects. In our eyes, this is a very positive step that Microsoft has taken, and while we'd rather most of those settings were off by default, we're glad that Microsoft has explained each setting thoroughly, so that you are mostly in control of your privacy when using Windows 10 Creators Update. ⚙️



You can also use your device as an ereader, with built-in support for ebooks.

SUBSCRIBE TO **MAXIMUM**PC

THE GO-TO RESOURCE FOR PC ENTHUSIASTS...

CHOOSE YOUR PERFECT PACKAGE



1

THE DIGITAL EDITION
ONLY \$9.00
EVERY YEAR

Instant digital access on your iPad, iPhone, and Android device.



2

THE PRINT EDITION
ONLY \$24.00
EVERY YEAR

Every issue delivered to your door for a fraction of the store price.

3

COMPLETE PRINT
& DIGITAL BUNDLE
ONLY \$28.00
EVERY YEAR

Get the print edition of *Maximum PC* delivered direct to your door, and instant access on your iPad, iPhone, or Android device.



On iOS & Android!



THE EASY WAYS TO SUBSCRIBE...

<http://bit.ly/max-subs>

Or call 844-779-2822 (toll-free)

TERMS AND CONDITIONS Prices and savings quoted are compared to buying full-priced US print and digital issues. You will receive 13 issues in a year. You can write to us or call us to cancel your subscription within 14 days of purchase. Your subscription is for the minimum term specified, and will expire at the end of the current term. Payment is non-refundable after the 14-day cancellation period, unless exceptional circumstances apply. Your statutory rights are not affected. Prices correct at time of print and subject to change. Call center opening hours are Monday to Friday 8am–7pm, and Saturday 10am–2pm EDT. For full terms and conditions, please visit <http://bit.ly/magtandc>. **Offer ends: June 27, 2017.**

TECH PORN

1 REAR I/O

Why no one has ever thought of this before is beyond us: a pre-installed rear I/O shield. It's simple. Just position the empty bracket prior to installation, and there's no messing around trying to line both up. Couple that with dual Ethernet ports, dual USB 3.1 Type C, USB 3.1 Type A, four USB 3.0 ports, and two additional USB ports for both KEYBOT and USB BIOS flashback, and this rear I/O is as premium as you can possibly get on the X99 platform.





2 MEMORY SUPPORT
DDR4 support up to 128GB of 3,333MT/s on the Rampage V makes this one mean motherboard. Together with quad-channel memory for all the bandwidth, and this board—even compared to its Ryzen competition—thrashes high-end computational tasks.

3 PCIE POWERHOUSE
Designed with gaming in mind, the Rampage V 10th Anniversary Edition features support for SLI/CrossFire configurations running in x16, x16 or x16, x8, x16 (or x16, x8, x8, x8, if you really want to get fancy). Plus, each slot is reinforced to minimize damage.

4 AURA RGB LIGHTING
Not content with that plethora of hardware connectivity support, you also get Asus's legendary Aura RGB lighting software, enabling you to synchronize the illumination of everything from your peripherals to your GPUs to these well-lit chipsets and VRMs.

Asus ROG Rampage V Edition 10

HIGH-END DESKTOP: that's the name of the game with this little beauty. X99 2011-3 Broadwell-E processors adorn this motherboard to create one mighty combination of processing prowess. It's certainly no slouch—but packing support for U.2, M.2, 10 SATA 6Gb/s ports, and a whole heap of rear I/O means this motherboard comes in at an incredibly pricey \$600.

So, why invest in the platform? Especially with Ryzen kicking Intel to the curb with its latest octo-core processors? Well, it's all down to that chipset. If you're looking for the best, Broadwell-E's support for up to 40 PCIe 3.0 lanes on the processors themselves makes any combination of graphics and PCIe SSD solution viable, running at full speed, with no bottlenecks.

On top of all of that, you get a tried and tested platform, used around the globe in professional render houses, design studios, and so forth. Which leads us on nicely to the fact that this board is purely for enthusiasts, for those looking for the best possible system that money can muster. You're likely to find this motherboard only in the highest of high-end liquid-cooled dream machines and gaming systems.

And with good reason, because it's a truly beautiful piece of art. The sleek black design, subtly accented by the RGB LEDs in both the chipset and the VRM heatsinks, makes this an exceptionally clean-looking motherboard. With its vast range of hardware support, superior audio, wireless A/C, reinforced backplate, and overclocking potential, it's a sure-fire bet to say that this must be the best-equipped motherboard we've ever clapped eyes on. **-ZAK STOREY**

DUAL-BOOT ELEMENTARY



& WINDOWS

Set up this slick Linux OS alongside Windows

By Nick Peers

Ever wanted to dip your toe into Linux, but felt put off by the user experience? It's time to confront your fear. Linux isn't as impenetrable as it looks, with Ubuntu providing a very user-friendly approach to getting started.

Ubuntu is a great flavor of Linux, but one of its biggest achievements has been to pioneer a host of off-shoot distros that focus on providing a more welcoming environment for those wishing to switch from other OSes. One obvious example is Linux Mint, an Ubuntu-derivative that uses the Cinnamon desktop to provide a Windows 7-like experience for switchers. Another—as you're about to discover—is Elementary OS.

Elementary is based on Ubuntu 16.04 LTS, and is perfect for those who like

their OSes to look sleek and modern. It's particularly attractive to Mac switchers, but while we'll touch on how you can install Elementary alongside OS X, our primary focus is configuring it in a dual-boot setup with Windows.

First, we'll show you how to repartition your hard drive to split off your data from Windows itself—this means you can access your personal files easily from either OS via a shared partition. You'll then build your Elementary install media, and we'll then step you through the install process. It's usually straightforward, but we've got your back covered in case it proves trickier than it should be.

We're not going to just abandon you at the Elementary login screen either—

there's time for a quick tour of the Elementary desktop, plus we'll reveal how to get started with the Terminal, and even replace the boring GRUB boot loader with something a little more visually appealing (not to mention more practical).

One final thing: Before diving in, give Elementary a test drive first in a safe environment. You can do this from the install media—choose "Try Elementary" at the main screen—or by installing Elementary in a virtual machine using the likes of VirtualBox (which you can download from www.virtualbox.org) for a more in-depth play. Once you're hooked, turn the page to start installing and using Elementary as your brand new operating system.

Before you can dive in and install Elementary, there's a bit of preparatory work to do. Take a drive image—so you can roll back if things go wrong—and then prepare to separate your data from your Windows drive. The simplest way to share data between Windows and Elementary is through a shared data drive, whether that's a separate physical drive or a separate partition.

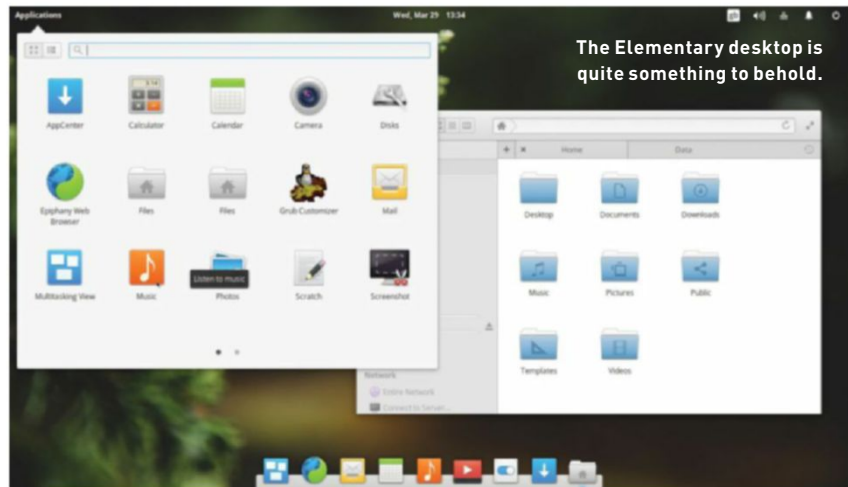
Once set up, you'll move across your key user folders—"Documents," "Pictures," and so on—to this drive, and update the references, so Windows knows where to look for your data going forward.

PARTITION YOUR DRIVE

If you're not using a separate physical drive to store your data, right-click the "Start" button, and choose "Disk Management." Locate your Windows drive (this is typically drive C on Disk 0), then right-click that, and choose "Shrink Volume."

Windows calculates how much free space it can give you—this may not tally with the total amount of free space on the drive, though, because of unmovable files. If you're adamant that you should be able to free up more space, but can't due to Disk Management's limitations, you need to use a third-party partitioning tool, such as Minitool Partition Wizard Free (www.partitionwizard.com).

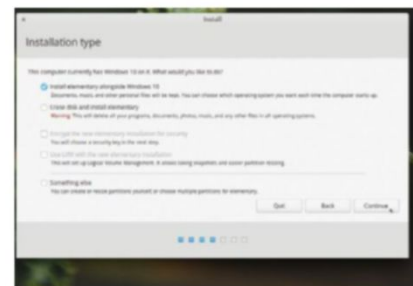
If you're lacking free space due to the presence of files already on the drive, consider moving the largest ones temporarily off the drive to your backup drive, in order to free up enough space for your new partition. Use a tool such as WizTree (<http://antibody-software.com>) to



help identify these, move them, and then restart the process.

Don't forget to free up enough space to accommodate Elementary, as well as your data—if you're installing everything on the same drive, Elementary always looks to place itself after your data partition. As a general rule of thumb, Windows needs a minimum of 32GB to run comfortably, but you'll soon run out of space, so you should look to ensure your Windows partition is at least 50GB in size, and much larger if you play a lot of games. The rest is then allocated to your data partition and—eventually—Elementary.

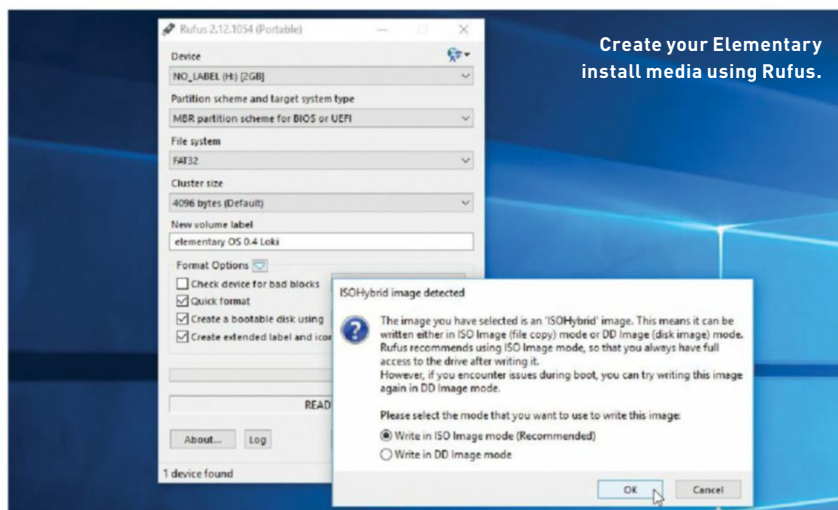
Here's an example. You have a 512GB hard drive. You could look to allocate around 150GB for Windows, leaving you 350GB for your data partition and Elementary. When you come to resize your partition, Windows asks you how much space you wish to shrink the partition by—in other words, how much space do you want to reserve for your other partitions? It's a bit awkward, because it lists the figure in MB rather than GB, so to free up 350GB of space, you need to enter



If detected, leave this option selected, then just click "Continue."

a figure like "350000" into the "Enter the amount of space to shrink in MB:" box.

Once done, click "Shrink," and wait for Windows to complete the process. You then see "Unallocated" space appear in the "Disk Management" window—right-click it, and choose "New Simple Volume." Follow the wizard, allocating all available space for now, assigning it a drive letter, and formatting using the NTFS filesystem. Give it a suitable label, such as "Data," and your new partition is ready to go.



MOVE KEY FOLDERS

It's time to move your key user folders to the new partition. Open File Explorer, browse to "This PC," then right-click each of your user folders in turn, and choose "Properties → Location tab." Click "Move," then browse to your data drive (consider creating a user folder inside which you then create subfolders for "Documents" and your other folders), select the new target folder, and click "OK." When prompted, click "Yes" to move your data across to the new partition. Once complete, you can then move any files you'd previously copied off the drive back on to it.

OBTAIN BOOT MEDIA

It's time to build your bootable Elementary installation media. Download the ISO file from <https://elementary.io>, where you can enter "0" in the "\$ Custom" field to avoid paying for it, then click "Download elementary OS." Save the ISO file to your hard drive—it's 1.3GB.

While you can right-click this ISO and choose "Burn image" to create a bootable install DVD, the disc is incredibly slow—a better option is to dig out a 2GB flash drive, download Rufus from <https://rufus.akeo.ie>, and use that to convert your flash drive into bootable media. Select your USB drive from the "Device" drop-down menu, choose "ISO Image" next to "Create a bootable disk using," and click the button next to it to select your Elementary ISO file.

Click "Start," leave the recommended "ISO Image mode" option selected, then click "OK" twice, and wait for the bootable media to be created.

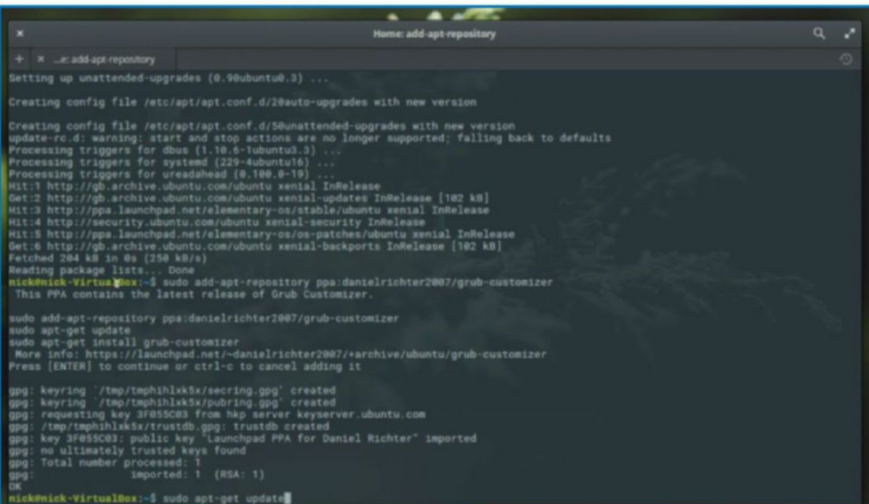
INSTALL ELEMENTARY

The moment of truth has arrived. It's now time to install Elementary itself. The process will be

familiar to anyone who's dabbled with Ubuntu Linux—it's practically identical. Start by booting with your bootable media inserted—if it's not automatically detected, reboot, and look for an option to access your boot menu at the beginning of startup; typically it involves pressing a key such as F10 or F11.

When the boot menu appears, look for your USB device—you may see two entries, in which case, select the one marked "UEFI." Once the install wizard appears, verify "English" is selected, and click "Install Elementary." If necessary, connect to your Wi-Fi network when prompted, then check both the "Download updates" and "Install third-party software" boxes, before clicking "Continue."

If all is well, your Windows installation should be detected—leave "Install Elementary alongside Windows 10" selected, and click "Continue." First, verify that Elementary has selected the correct disk to install itself on to—if you have more than one internal hard drive, it may attempt to install itself on the second drive. (If this is the case, you have two choices: either click "Back," and skip to the "Manual Partitioning" section below, or power off your PC, open it



USE THE TERMINAL

Elementary's gorgeous visuals belie the fact that—underneath it all—you're running an offshoot of Ubuntu Linux. Linux is a powerful operating system, and to really get to grips with it, you need to start familiarizing yourself with the Terminal, which gives you direct access to Linux's underlying shell. You can open it via the "Applications" menu, or simply press Win-T to bring it up.

Here's your first useful set of commands—we find the App Center can sometimes hang, but you can update Elementary and all your installed apps directly using the following commands:

```
$ sudo apt-get update
```

```
$ sudo apt-get upgrade
```

The next set of commands install the Grub Customizer tool, which enables you to tweak the GRUB boot loader (for example,

to change the default operating system back to Windows 10, if you prefer):

```
$ sudo apt-get install software-properties-common && sudo apt-get update
$ sudo add-apt-repository ppa:danielrichter2007/grub-customizer
$ sudo apt-get update
$ sudo apt-get install grub-customizer
```

Once complete, launch Grub Customizer from the "Applications" menu, and move Windows 10 to the top of the list, to make it the default choice.

The Terminal—and underlying Linux shell—uses the BASH language. It's quite simple to pick up, and you'll find lots of built-in help to get you started. Use the following command to start familiarizing yourself with the Terminal:

```
$ man intro
```



Use the slider to choose how much space to allocate to Elementary.

up, temporarily disconnect the second hard drive, and try the install process again. Once Elementary is installed, reconnect the drive.)

Assuming you're happy with the choice of drive, Elementary attempts to allocate itself around half of all available space, but you can use the slider to alter this as you see fit. For a basic Elementary installation,

25GB should be ample, but if you plan to run games on it, you'll want to give yourself plenty of extra breathing room—50GB or even more. Click "Install Now," and jump to "Complete installation."

MANUAL PARTITIONING

In some rare cases, Elementary won't detect your Windows installation—the option for installing

it alongside Windows won't be visible. If this is the case—or you wish to manually partition the drive for any other reason—choose "Something else," and click "Continue." Identify your data partition by its size and position on the disk (it'll be the second large partition), then select it, and click "Change." Reduce its size by the

number of megabytes required to free up space for Elementary (25,000 for 25GB, for example), and leave “Do not use the partition” selected, before clicking “OK,” followed by “Continue.”

When the space has been freed up, select the “free space,” and click the “+” button. Set the size in “Create partition” to 4096MB, to create a 4GB swap file (ample for most setups), select “End of this space,” click the “Use as” drop-down, and set to “Swap area.” Click “OK.” Finally, select the remaining free space, and click “+” again. Leave all the settings as they are except for the “Mount point”—click this, and set it to

“/”. Click “OK,” then “Install Now.” Review the proposed changes, and click “Continue.”

COMPLETE INSTALLATION

Once the drive is partitioned, verify the time zone is correct, and click “Continue.” Check the keyboard layout matches your language and your keyboard, and click “Continue” again.

Next, you’re prompted to enter your name, give your PC a name to identify it on

your network, then adjust the username if required, before setting a password and choosing whether to log in automatically. Click “Continue,” and leave Elementary to install itself. When done, you’re prompted to disconnect your Elementary install drive or eject the disc, then press [Enter].

Your PC reboots, and you see the new GRUB loader for the first time, giving you a choice of Elementary or Windows 10. Select “Windows 10” to verify you can boot back into Windows, then reboot again. This time, leave “Elementary” selected, and hit Enter, or wait for it to start loading on its own.

Once you reach the login screen, things will start to feel familiar—Elementary may be based on Linux, but its point-and-click desktop is much closer to Windows (or macOS).

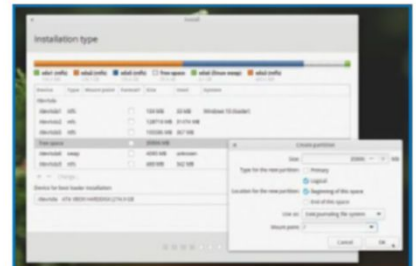
FIRST STEPS

The Elementary desktop consists of three primary areas: at the bottom is the Dock, with shortcuts

to various apps, as well as the App Center (where you keep Elementary up to date), and any icons representing open programs.

You should see the App Center icon show a number, which indicates there are updates available. Click it to open the App Center, switch to the “Updates” tab, and you’ll find various updates—including crucial OS updates—are waiting for you. Click “Update All,” and enter your user password when prompted to provide elevated access. You’ll see progress bars appear as updates are downloaded and installed—as you’re installing OS updates, you may be prompted to reboot when the process is complete.

While you wait, familiarize yourself with the other key areas of the desktop. The “Applications” shortcut, top-left, reveals a pop-up menu giving you access to all your apps, which can be viewed alphabetically or by category, while a Search tool helps you target specific apps, settings, and even actions within apps (such as options for taking screenshots, for example). Open an app, and its icon appears in the Dock. To



If Windows isn’t detected, set up Elementary’s partitions yourself.



AN ALTERNATIVE BOOT MANAGER

GRUB is a perfectly acceptable boot manager for most people, but if you’re looking for something more visually appealing (or you’ve installed Elementary on a Mac), then you should look to replace it with the rEFInd Boot Manager. Note that rEFInd only works on computers that use a UEFI rather than a BIOS—this should cover most modern PCs (and Macs from 2006 onward).

Once Elementary has been installed, open the Terminal, and enter the following commands to install rEFInd (you should skip the first command if you’ve previously installed software-properties-common):

```
$ sudo apt-get install software-properties-common && sudo apt-get update
```

```
$ sudo apt-add-repository ppa:rodsmith/refind
```

```
$ sudo apt-get update && sudo apt-get install refind
```

Once installed, answer “Yes” at the screen that appears, then wait for rEFInd to finish installing itself. Reboot your

PC, and you should find GRUB has been replaced with a friendlier, more visually appealing alternative—use the mouse or keyboard to move between options, and note that rEFInd automatically selects the last-used operating system as the default choice the next time you reboot your PC.

You can also install rEFInd without adding the repository: Open the Epiphany web browser from the Dock, and go to www.rodsbooks.com/refind/getting.html, where you should click the “binary zip file” link to save the refind-bin-0.10.5.zip file.

Once complete, click the file to open the “Downloads” folder. Right-click the zip file, and choose “Extract Here.” Open the newly created “refind-bin” folder, then right-click inside the “Files” window, and choose “Open With → Terminal.” Finally, type the following command:

```
$ ./refind-install
```

Enter your account password when prompted, and a series of messages should appear confirming that rEFInd is the default boot manager.

make it a permanent fixture, right-click the Dock icon, and choose “Keep in Dock.”

If the Dock is your taskbar, and the Applications pop-up your “Start” menu, the icons at the top-right represent your taskbar notification area. Here you’ll find handy shortcuts to network settings, music and sound, language settings, and the power button (including user-switching settings, as with Windows). Other things to note: “System Settings” under “Applications” is your Control Panel, while the Files app enables you to browse your hard drives.

AUTOMATIC DATA PARTITION MOUNTING

By default, only your Elementary partition is mounted at startup—while you can manually mount

your data partition each time you boot, it’s better to have it mount automatically.

Install the Disks utility from the App Center. Launch the app, select your drive in the left-hand pane, then highlight your data partition in the right, and click “Settings” beneath it. Choose “Edit mount options” from the pop-up menu, and slide the “Automatic Mount Options” switch to off. Leave “Mount at startup” and “Show in user interface” checked, then change the “Mount Point” to match the drive’s current mount point (listed under “Contents” in the main “Disks” window). Click “OK,” supply your password, and click “OK” again. When you next reboot into Elementary, you should find the data partition is already mounted.

FINAL DETAILS

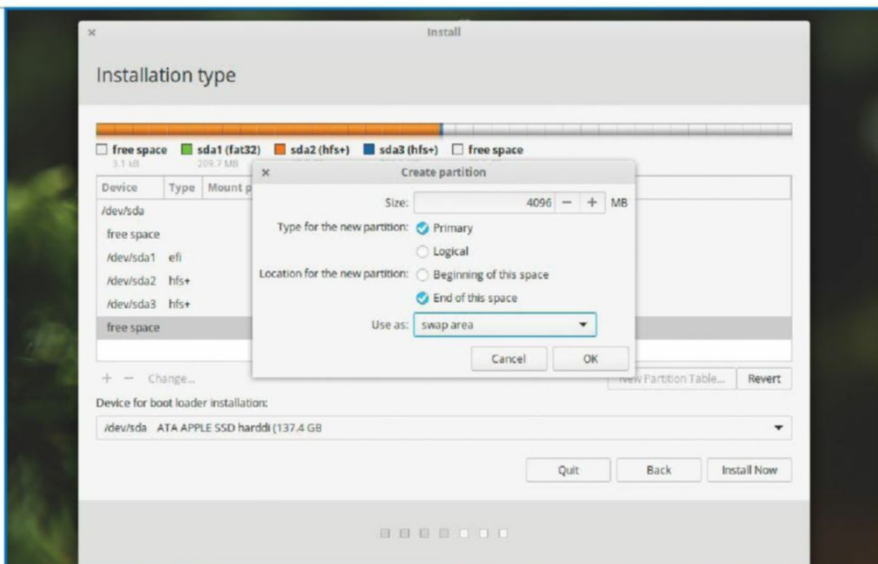
You’re ready to be let loose with Elementary, but there are some things to note: If you don’t like the default

Files manager (it’s a bit simple), try searching for “nautilus” to install Ubuntu’s more powerful substitute (confusingly also called Files). Another alternative to consider is Synaptic Package Manager in place of App Center for a wider range of apps (and easier management of repositories).

Finally, install Elementary Tweaks (you need to install software-common-properties—see the “Terminal” box):

```
$ sudo add-apt-repository ppa:philip.scott/elementary-tweaks
$ sudo apt-get update && sudo apt-get install elementary-tweaks
```

Once installed, access it via “System Settings” under “Personal”—click “Tweaks” to uncover more tweakable settings. ⚡



INSTALL ON MAC

One of Elementary OS’s biggest selling points is to Mac users fed up with OS X (or running an older Mac that’s no longer supported). The good news is that with a little tweaking, you can easily adapt our instructions to install Elementary alongside OS X.

You need a Mac running OS X 10.6.8 or later, with a dual-core processor, and 2GB of RAM. You must also install the rEFInd boot manager before you begin the process, to allow your Mac to boot from the Elementary install media.

This is straightforward enough, but if you’re currently running OS X 10.11 (El Capitan) or later, you need to temporarily disable SIP (System Integrity Protection)—reboot your Mac holding Cmd-R until the Apple logo appears. When the recovery environment starts, choose “Utilities → Terminal.” Type “csrutil disable” and hit Enter, then restart your Mac.

Now download the binary zip file from the link in the “Alternative boot manager” box—it should automatically extract its contents—and open Terminal via “Applications → Utilities.” Drag the “refind-install” script file from inside the “Downloads” folder into the Terminal window, hit Enter, and provide your administrator password. When “Installation has completed successfully” appears, reboot your Mac, and rEFInd is now installed.

El Capitan and Sierra users should then

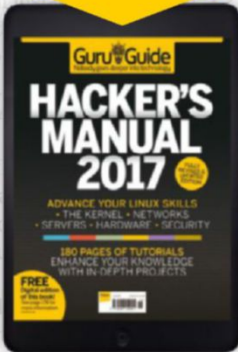
select “Apple Recovery” from the new boot menu to go back to the recovery environment to bring SIP back (type “csrutil enable” at the command prompt).

You then need to partition your drive using Disk Utility, to free up space for your Elementary installation, then boot from the install media, and install Elementary in the same way as outlined in the main text, following the “Something else” option when prompted (it won’t detect OS X). After installation completes, you need to reinstall rEFInd in Elementary to replace GRUB—see the box opposite.



TAKE YOUR LINUX KNOWLEDGE FURTHER

**OUT
NOW!**
WITH
**FREE
DIGITAL
EDITION**



GuruGuide
Nobody goes deeper into technology

HACKER'S MANUAL 2017

FULLY
REVISED &
UPDATED
EDITION

ADVANCE YOUR LINUX SKILLS
• THE KERNEL • NETWORKS
• SERVERS • HARDWARE • SECURITY

180 PAGES OF TUTORIALS
ENHANCE YOUR KNOWLEDGE
WITH IN-DEPTH PROJECTS

FREE
Digital edition
of this book!
See page 178 for
more information



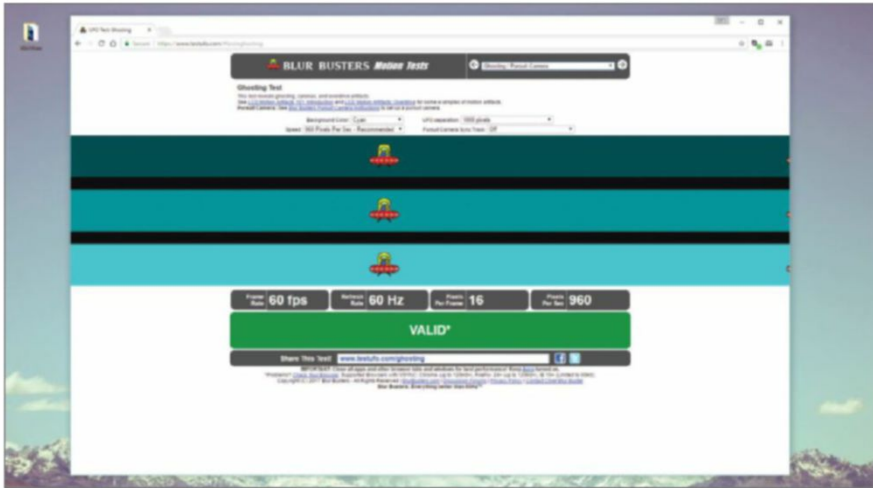
DELIVERED DIRECT TO YOUR DOOR

Order online at <https://www.myfavouritemagazines.com>
or find us in your nearest supermarket, newsagent or bookstore!

HOW TO

STEP-BY-STEP GUIDES TO IMPROVING YOUR PC

TIP OF THE MONTH



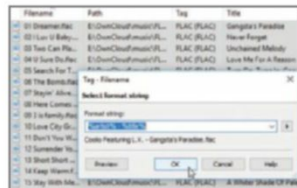
CHECK YOUR SCREEN

One of our dedicated panel reviewers picked up some handy tools recently over on the nifty www.testufo.com website. The site offers a whole plethora of different web-based tests to see just how your monitor is performing, including one designed to examine how bad your panel's ghosting situation is. On top of that, there's also a neat 15, 30, and 60fps side-by-side comparison to show all your console-loving buddies.

MAKE – USE – CREATE



60
Run a neural network on your Raspberry Pi



64
Become a metadata master with Mp3tag, and manage music



72
Follow our guide to building a gorgeous gaming rig



ZAK STOREY
REVIEWS EDITOR

WINDOWS ACTIVATION

Oh, Windows 10, you're good. You may be helping yourself to my personal data, but the promise of a free upgrade to the latest OS was too tempting to resist. I jumped ship, leaving the sunny confines of my safe and secure Windows 7 license in favor of Windows 10. At least, I did at home. I remember it well: I'd just joined the *Maximum PC* team, a young, unsullied graduate, ready to start my working adventures in an environment I was passionate about. I had a Windows 10 PC at home, and a brand new system to build in the office.

But what should I use in the office? Well, the promise of a free version of Windows 10's technical preview was too enticing to ignore. All you had to do was join the Insider Program, run the latest tech preview, and you were good to go. Soon after, though, Microsoft launched its latest OS, and this generosity was revoked.

For around six months, I put up with the "Activate Windows" watermark, until I tried enabling the Insider Preview Builds once more, with the Fast level selected. The watermark having temporarily disappeared for some reason, I assumed my version was activated. It wasn't. And I didn't discover that until after I'd written the \$300 Build It challenge. So today, long past Win 10's free upgrade path, you can no longer get a copy for free. I stand corrected. And annoyed.

submit your How To project idea to: comments@maximumpc.com

**IFIXIT**

presents:

AUTOPSY

MONTH WE DISSECT...



About iFixit

iFixit is a global community of tinkerers dedicated to helping people fix things through free online repair manuals and teardowns. iFixit believes that everyone has the right to maintain and repair their own products. To learn more, visit www.ifixit.com.

MacBook Pro 15" Touch Bar



The world's
most superglued
battery—don't
you dare try to
change it.

The only easy
part of this
entire teardown.



BACKGROUND

Apple has announced a trio of new laptops, and today we're looking at the top of the line, with its new Touch Bar, which attempts to replace our tried-and-true function keys. It's time to tear down the 15-inch MacBook Pro with Touch Bar!

MAJOR TECH SPECS

- 15.4-inch LED-backlit Retina Display with 2880x1800 resolution (220dpi), P3 color gamut
- 2.6GHz Skylake quad-core Intel Core i7 (Turbo Boost up to 3.5GHz), with integrated Radeon Pro 450 with 2GB of GDDR5
- 16GB of 2,133MHz LPDDR3 onboard memory
- 256GB PCIe-based onboard SSD (configurable to 512GB, 1TB, or 2TB SSD)
- Four Thunderbolt 3 (USB-C) ports supporting charging, DisplayPort, Thunderbolt, USB 3.1 Gen 2
- Touch Bar with integrated Touch ID sensor
- Force Touch trackpad

KEY FINDINGS

- On initial inspection, the 15-inch MBP looks like a scaled-up version of the 13-inch model. We do notice a difference in the battery layout, but overall it's like looking at twins. And look what we ran into! A connector to nowhere. Apple may have included this to access the soldered-in SSD for data recovery. We'd rather see a removable/upgradeable SSD, particularly in a machine targeted at pros—but this way, if your logic board bites the dust, there might at least be a chance of recovering your data with Apple's help.
- Anxious to get a peek at Apple's re-engineered thermal architecture, we free the fans from the four T3 screws securing them to the rear case. And they come out hassle-free. No glue on this puppy! On the outside, that is. Opening up the fan takes some seriously aggressive prying against clips and adhesive.
- This 15-inch MacBook Pro has a similar speaker grille to its smaller 13-inch counterpart. Most of the grille doesn't include full through-holes, prompting us to question, why the dimples, Apple? Survey says: weight-savers, so it goes faster when you put wheels on it.
- After accidentally separating the digitizer from the OLED panel, we turn our tools to the LED display. Two teardown engineers, an opening pick, X-Acto knife, isopropyl alcohol, a heat gun, and an iOpener all came to this OLED teardown party, but Apple's adhesive was still too much for our glue separation squad. Thwarted by the monstrous amount of adhesive holding the OLED panel in place, we resign ourselves to flecking away shards of glass.
- Repairability Score: 1 out of 10 (10 is easiest to repair). The trackpad is easy to access and straightforward to replace. Use of proprietary pentalobe screws makes servicing and repair unnecessarily difficult. The entire battery assembly is strongly glued into the case, complicating replacement. The processor, RAM, and flash memory are soldered to the logic board. The Touch Bar adds a second, difficult-to-replace screen to damage. The Touch ID sensor doubles as the power switch, and is paired with the T1 chip on the logic board. Fixing a broken power switch may require help from Apple, or a new logic board. ⚡

Run a Neural Network on Your Raspberry Pi

YOU'LL NEED THIS

A RASPBERRY PI

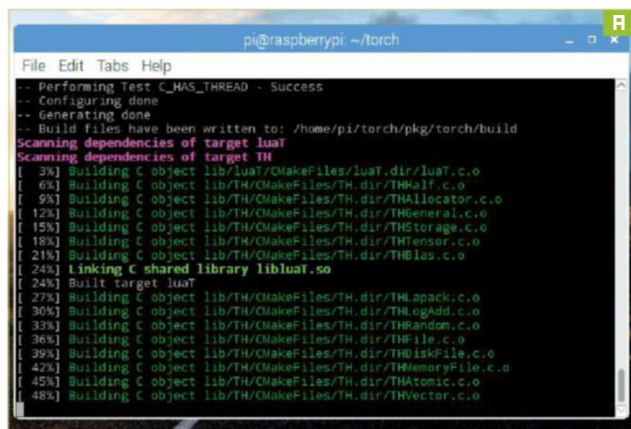
This is processor-intensive, so a model 3 is ideal.

CHAR-RNN

Head to <https://github.com/karpathy/char-rnn> to get it.

AT LEAST UNTIL they power the inevitable robot uprising that will one day enslave the citizens of Earth, recurrent neural networks are great fun to play with. They generally consist of deceptively simple code—in this case, a package called Char-rnn, supplied by Stanford Computer Science PhD student and neural network expert Andrej Karpathy, which is a slightly expanded version of his 100-line original, coded in Lua for the Torch deep learning framework.

In base terms, you feed Char-rnn a source document containing the sort of thing you'd like it to learn to create—we'll show you a couple of examples of this—and set it to grind away. As it does so, it analyzes the original, firing neurons in a virtual brain as it begins to recognize patterns and structures, learning what you find desirable based on that input. Because this is a "recurrent" neural net, it is influenced not only by that single input, but by the history of everything it's learned in the past, and when you later ask it for a sample, it calls upon its learning experience to generate results. Andrej Karpathy's extensive blog post (<http://karpathy.github.io/2015/05/21/rnn-effectiveness>) explains much more. —ALEX COX



1 DOWNLOAD AND INSTALL

There's a lot to get sorted on your Raspberry Pi before you can begin thinking—and, since it's relatively short on processing power, you'll have to wait a while for everything to install and compile. Begin with a fresh install of Raspbian, if you can, and open up the terminal app by clicking the appropriate icon at the top of the desktop. First, type `git clone https://github.com/torch/distro.git ~/torch --recursive` to pull the files required for Torch from GitHub, and place them in your home folder, then type `cd ~/torch; bash install-deps` to furnish your Raspberry Pi with everything Torch needs to run. This takes a while, but not quite as long as the final install process [Image A], which is done by typing `./install.sh`. Now enter `source ~/.bashrc` to add the path to Torch to your environment variables, then install the extra Lua components that Char-rnn requires using `luarocks install nngraph`, `luarocks install optim`, and `luarocks install nn`. Finally, let's pull down the Char-rnn package from GitHub using `git clone https://github.com/karpathy/char-rnn.git`.

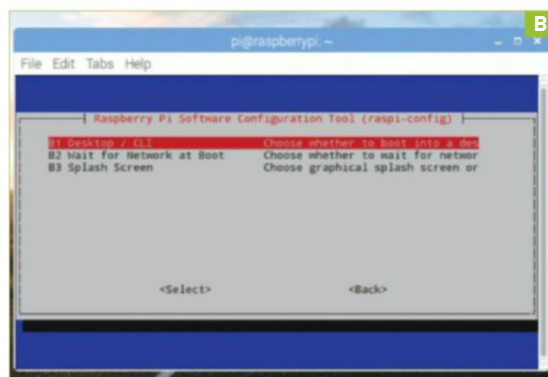
2 SET UP YOUR PI

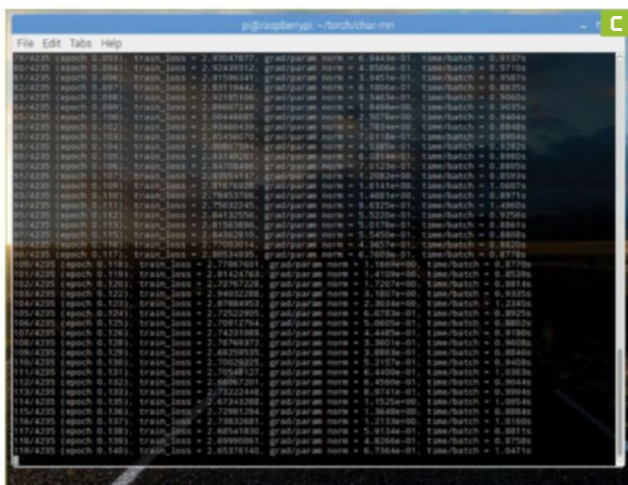
We're not quite ready to go. It's important to give Char-rnn the largest resources possible to do its task; it's very easy, if you're working with a lot of data, to exhaust the Pi's rather feeble

1GB of RAM, particularly as that's shared between the GPU and video output. To fix this, run `sudo raspi-config` [Image B] in a terminal window. Let's do away with the Raspbian GUI on the next boot (option 3, B1, B2 to jump directly to a logged-in command line), and allocate as much RAM to system memory as we can (option 7, A3, and set the GPU memory value to 16MB). Reboot your Pi (type `sudo reboot` into the command line to do this quickly) and we're now ready to run.

3 START THINKING

You can set Char-rnn thinking with the default options, working on the included Tiny Shakespeare dataset, by typing `th train.lua -gpuid -1`, which tells Torch (th) to run the training file (train.lua), without using GPU processing ("-1" being the gpu id of "no GPU"). But it won't work. After about 100 iterations through the code, it crashes with a segmentation fault, because the Raspberry Pi's RAM is completely exhausted. We have to be more conservative; append `-batch_size 25` to the command to force Char-rnn to work with smaller portions of the original data. This, however, still isn't brilliant, because the process will take a good 21 hours to complete, so also append `-max_epochs 5` and `-num_layers 1` to scale things back even further.

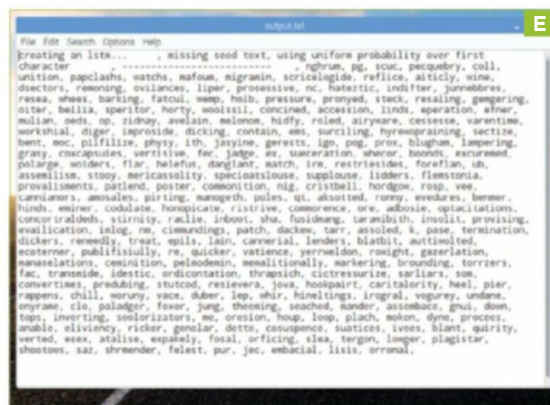
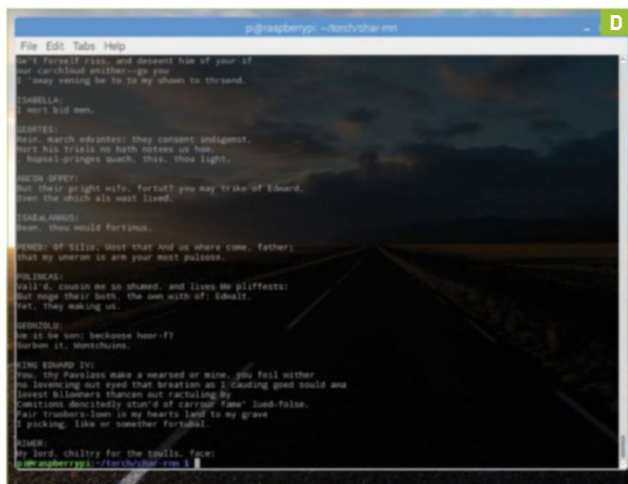




4 WHAT'S HAPPENING?
As Char-rnn thinks, it prints its output [Image C], and you can watch its intelligence increase with every step. Keep an eye on the “train_loss” value, which will likely start at around 4, and work its way toward 0 as the network processes. Every so often, by default every 1,000 steps, it saves a log of its training data in the “/cv” folder, meaning you can later go back and check them out, and it also saves one when its allocated processing workload is complete—in our case, after five epochs, or complete passes over the original training data. If you ever want to stop the process before it’s fully complete, just hit Ctrl-C.

5 TEST OUTPUT
As long as you have at least one checkpoint saved in the “/cv” directory (type `ls ~/torch/char-rnn/cv` to see its contents), you can sample some output from it, bearing in mind that earlier checkpoints will be significantly more stupid than later ones. Just type `th sample.lua -gpuid -1 cv/<name of checkpoint>` to display some output on screen [Image D], or append `> output.txt` to pipe that output to a text file.

6 DIFFERENT DATA
Of course, you’re not restricted to the original dataset. You could process just about anything through your neural net, as long as you can put it in a plaintext file—Char-rnn looks for a file called “input.txt” in a folder underneath the “/data” directory. Let’s give it a try with a set of the 20,000 most popular American



English words, based on Google’s enormous language training corpus. First, you need to head to the correct place [`cd ~/torch/char-rnn/data`], then create a new folder [`mkdir words`], and head into it with `cd words` . Use `git clone https://github.com/first20hours/google-10000-english.git` to download a set of words, then use `mv /google-10000-english/20k.txt ./input.txt` to move the appropriate file and rename it. You can now get Char-rnn pondering this new dataset by adding `-data_dir data/words` to our original training command. It drops its checkpoints into the same “/cv” directory as the other training data, so append `-savefile words` to change the filename, and make its checkpoints easily identifiable. The results [Image E] can be quite amusing. 🔌

MORE POWER, MORE SPEED

OK, we’ll admit it: Recurrent neural networks are not necessarily best suited to the low-powered environment of the Raspberry Pi, because they demand a fairly heavy computational overhead. This is particularly true if you want your processing to complete quickly. If you have heftier hardware around, it’s more than possible to run Torch and Char-rnn elsewhere, and even take advantage of your GPU for a burst of extra processing speed using CUDA, or OpenCL on AMD cards. Annoyingly, we can’t see a way to use Torch on non-Linux environments, so you’ll need to fire up Ubuntu or similar, get your graphics card drivers sorted out, and, in addition to the modules we installed in the main guide, run (for CUDA) `luarocks install cutorch` and `luarocks install cunn` , or (for OpenCL) `run luarocks install cltorch` and `luarocks install clnn` . Then, when activating the training script, omit the “-gpuid -1” argument to use the default GPU, and add “-openc1 1” if you’re on AMD hardware. Now feel free to add extra layers of processing with “-num_layers” and increase your batch size as you see fit.



Create a Cool Color Splash Effect

YOU'LL NEED THIS

PHOTOSHOP

Available from www.adobe.com.

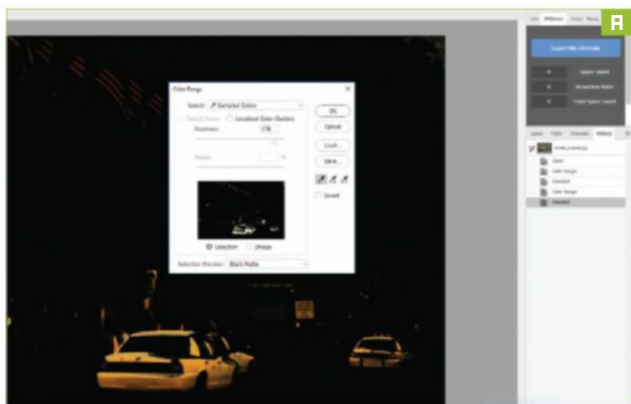
A SUITABLE PHOTO

Choose an image with a strong, isolated color in it.

THERE'S A PHOTOGRAPHIC EFFECT you may have seen if you're friends with any parents on Facebook. An image is drained of color, apart from specific hues, which are injected back into the otherwise monochrome image.

It's a bit overused—and, if we're being honest, groan-inducing, especially when applied to photos of newborn babies—but by recreating it, we can gain some insights into how Photoshop works, because it's possible to do it in a couple different ways, depending on whether you choose to work on the colors involved specifically, by selecting them directly, or just the area you want to work on more generally, by selecting the pixels in a certain area, no matter what color they are.

It's a relatively simple effect, albeit a striking one, so is something you could achieve in image-editing apps other than Photoshop. And if you can use it to make a new mom smile, then we've all made the world a better place. —IAN EVENDEN



1 CHOOSE A PHOTO

We're going to work on a photo of typical city scene here, but you could use anything with a strong, isolated color in it, such as a baby with piercing eyes, or a woman with full, red lips. Whatever you choose, open the image in Photoshop and, for the first of our color isolation methods, head to the "Select" menu, and choose "Color Range" [Image A].

2 SELECT COLORS

In the window that opens, you have the choice of being able to select colors in a range—reds, say—or by sampling an area with the eyedropper, which functions more or less identically to the main Eyedropper tool in Photoshop. By sampling the yellow cab with the dropper, it appears white in the small preview. You can expand this to the main image by choosing "Grayscale" from the "Selection Preview" drop-down, which makes for a very odd image, but lets you see exactly what you're selecting. Once you're happy with what you've sampled, click "OK," and the familiar marching ants of the Photoshop selection now wall off those pixels. You'll almost certainly select some additional colors that you don't want by using this method, so use the Quick Selection tool in conjunction with Shift and Alt to add and remove selected areas.

3 EYEDROPPER EXCELLENCE

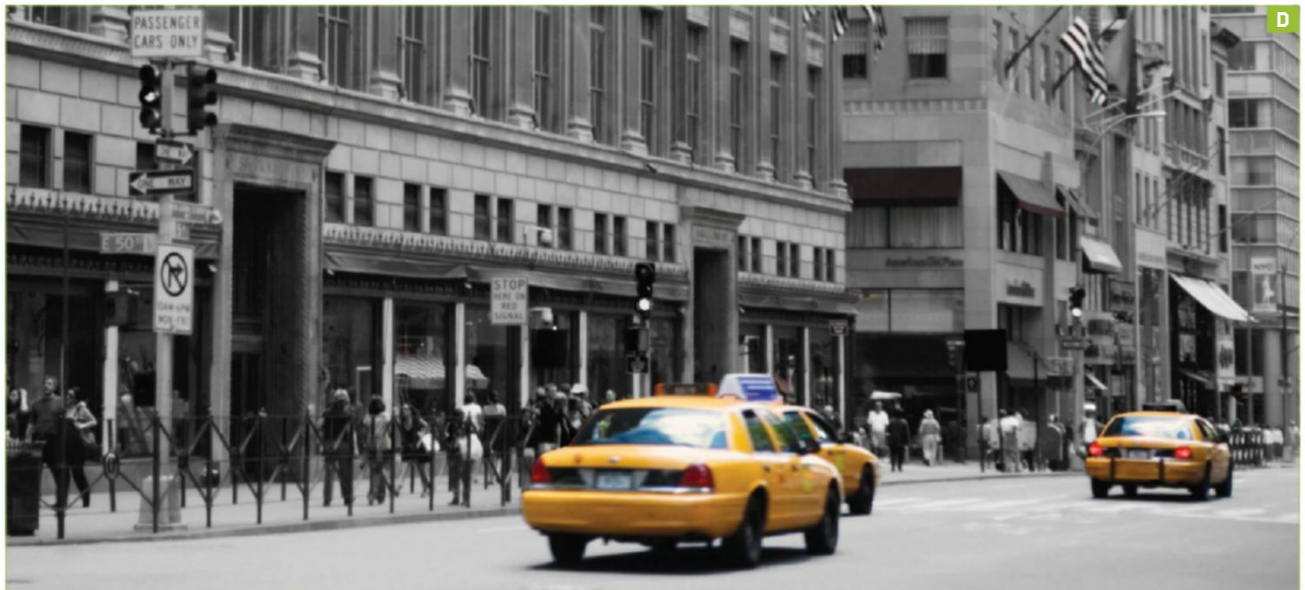
An interlude: Speaking of color selection and eyedroppers, here's something that blew our collective mind when we

found out about it. The Eyedropper tool isn't confined to Photoshop. It works across your whole monitor, so if you want to sample a color from a web page, you can, just by having the page open, and dragging the tool across from Photoshop. Your color selection must start within Photoshop, but once you're sampling, you can drag the dropper anywhere on your screen, release, and have the color information sampled to Photoshop. Neat, huh?

4 DECOLORIZE THE BACKGROUND

Back to business. Now you want to remove the color from the rest of the image, so invert your selection ("Select → Inverse"), and head to the Layers palette. At the bottom, there's an icon that looks like a circle divided in half. Part black, part white. Click it, and a menu pops up with all the different Adjustment Layers you can add. Choose "Black White," and you should instantly get your desired effect. There are still plenty of options to mess around with, though, including some presets (we've used High Contrast Blue [Image B]) and sliders to manually adjust the effect. If the color that remains isn't as bright as you'd like, bring back the selection ("Select → Reselect," then "Select → Inverse"), before using the Hue/Saturation Window ("Image → Adjustments → Hue/Saturation") to bring out the color more strongly.





5 STEP BACK IN HISTORY

The second way of achieving the same effect uses Photoshop's History Brush and the History palette's Snapshot ability. Reopen your original image file, and open History ("Window → History"). At the top of the palette, you'll find an automatically generated Snapshot, probably labeled with the image file name. You can create more at any time using the camera icon at the bottom of the History palette. This is a record of the image at the moment the Snapshot was created. They don't save with your image file, unfortunately, so be sure not to close and reopen your file while doing this.

6 USE THE SNAPSHOT

Your image is probably in RGB color at the moment, so we're going to remove the color information by going to "Image → Mode → Grayscale," and clicking "Discard." Then, we're going to put it back into a color mode by going to "Image → Mode → RGB Color." Note that your image stays black and white—the color information that has been discarded is gone forever. But not quite: There's a Snapshot at the top of the History palette that still remembers the colors. We can bring them back by using the History Brush. Make sure the box to the left of the Snapshot is selected in the History palette, then use the History Brush tool (Y) to paint over the areas

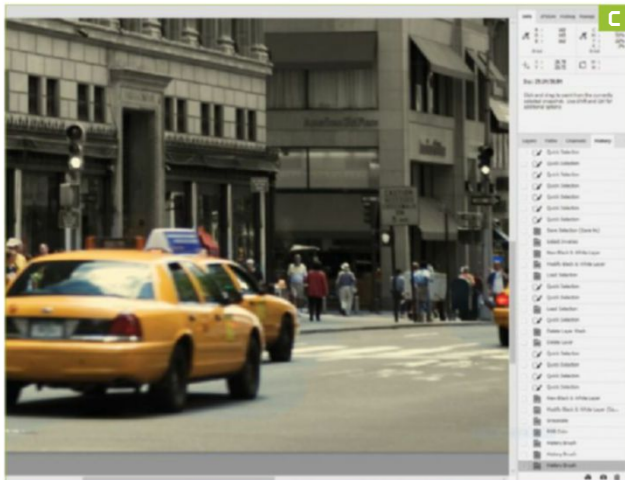
to which you want to bring the color back. We've painted very sloppily around the taxis to show the effect [Image C].

7 CAREFUL COLORING

You need to be quite accurate here, because you really only want the taxis to be in color, and not passers-by or the road surface, which has a blue tint. Be patient. Whatever the object you're re-coloring, you don't want that color bleeding into the background or other nearby objects. Use a tiny brush and zoom right in if necessary. To make things easier, you may like to select the area you want to color, as while there's an active selection, you can't paint outside of it. Feather the edges by a few pixels for a smooth transition using "Select → Modify → Feather."

8 FINAL TWEAKS

You can paint the History Brush state on to a new layer if needed, so the effect can be blended back into the original. To do this, make a new layer, and ensure it's selected before you begin painting. Save as a PSD to preserve your layers, and export as a JPEG for sharing or printing [Image D].



THE HISTORY PALETTE

The History palette was one of the most useful additions to Photoshop back in version 5—it's essentially one long undo tool. It lists every action you have performed, and allows you to step back through them just by clicking. You can change how many steps it remembers in the "Performance" section of "Preferences." It's 50 by

default, which should be plenty for most purposes. Snapshots are useful for preserving states that would be lost from the palette as you create more entries in it. We've used a Snapshot here, but you can use any state on the palette as a source for the History Brush by checking the box to its left.

Become a Metadata Master with Mp3tag

YOU'LL NEED THIS

MUSIC

A collection of untagged or incorrectly tagged music or music video files.

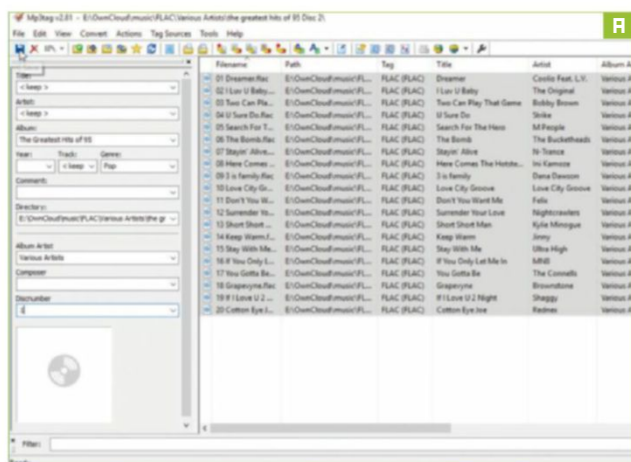
MP3TAG

Download the software from www.mp3tag.de/en.

MUSIC FILES NEED TO BE TAGGED—without the correct metadata in place, how do you know the track you've selected is the right one? If you use Windows Media Player to rip your CDs, you'll find its relatively small database often produces incorrect matches (and beyond that, no matches at all). You could spend hours manually entering this information in Windows Media Player's arcane interface, or you could employ the services of a tool that makes managing music (and music video) files much simpler.

The tool in question is Mp3tag, which can be installed as a regular application or run as a portable tool. Point it toward a directory of media files, and you can review existing tags, update tags for individual tracks or entire albums, and—crucially—tap into various online databases to find the correct tags (and artwork) to apply to your tracks.

Mp3tag supports a wide range of formats and tag standards, spanning everything from MP3, WMA, AAC, and MP4 to FLAC, APE, OGG, and WAV. It's easy to use, so we'll rush through the basics, then focus on its more advanced features. One thing's for certain: If you've been struggling to keep your music collection properly tagged, you're about to experience nirvana. —NICK PEERS



1 THE BASICS

Open Mp3tag, and select "File → Change Directory" to choose a directory containing a single album of tracks. Once located, click "Select Folder." A list of files appears, complete with any current tags. Select one item and you can manually edit its tags, plus add or change artwork by dragging an image file from a File Explorer window into the artwork box. You can also edit multiple files at the same time by Ctrl-clicking them [Image A]. Be sure to click the "Save" button when you're done to update the tags.

2 QUICK-FIRE TIPS

Made a mistake? Use the buttons or "Edit" menu to undo recently saved changes or remove tags entirely. When editing multiple items, you'll see options such as "<keep>" which instructs Mp3tag to leave that tag alone (it's set by default for certain tags, such as Title).

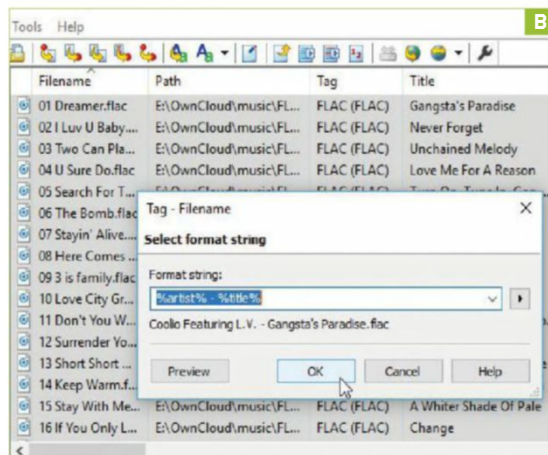
» Need to rename your original files to match the new tags? Open the "Convert" menu [Image B], where you can quickly apply your choice of tags to the file name (or vice versa). Tweak the "Format string:" box to include the information you wish—click ">" to quickly insert other elements, such as album or artist.

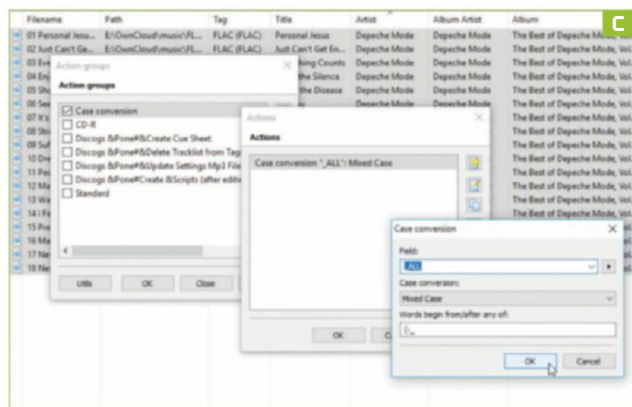
3 MAKE USE OF FILTERS

If you select an artist folder, then all files within that folder—including those inside album subfolders—are displayed. Press F3 to reveal the "Filter:" window. Use this to filter by keyword or make use of filter expressions (see "Help → Contents → Filters") to create sophisticated matches using fields (including file format, artist, and files without tags), and various matches, from IS and NOT to GREATER (than) and MISSING.

4 USE ONLINE DATABASES

Filling in tags by hand is, frankly, excruciating, which is where the "Tag Sources" menu comes into play. Select your tracks, then open "Tag Sources." You'll see several popular online databases, including Freedb, MusicBrainz, Amazon, and—our personal favorite—Discogs. The first time you use one you may have to log into your online account to authorize Mp3tag—just follow the prompts. Once done, you're prompted to search by album title (which may already be pre-filled, if the album tag exists). Amend this if necessary, then click "Next."





5 FOLLOW THE WIZARD

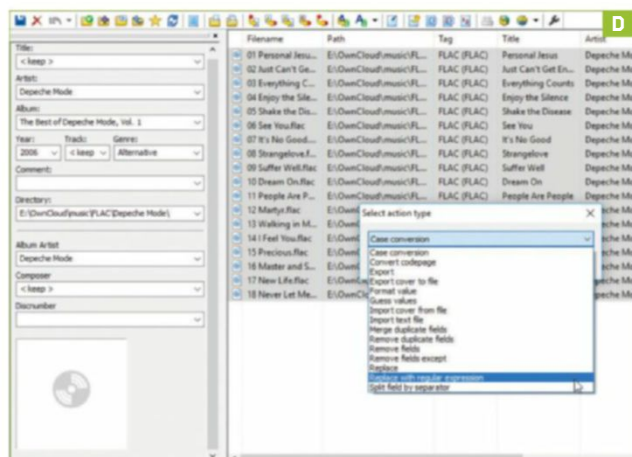
If you get an authorization error for Discogs, remove any punctuation from the album title, and click "Next" to try again. A list of matching results appears. Select the correct one and click "Next." You'll see a screen providing you with album information and a list of tracks. You need to drag and drop your tracks in the right-hand pane to match them up correctly (or use the "Move up" and "Move down" buttons). If you're only matching a few tracks, place the "no association>" entries next to tracks you don't want to match. Click "OK" when you're done. The tags are applied to your tracks.

6 ADD MORE DATABASE OPTIONS

You can download user-written scripts to add more options to the "Tag Sources" menu. For example, the Discogs search tool only works with album titles, which doesn't always produce the correct result with generic matches (such as "Greatest Hits"). The box, below-right, reveals an example using Discogs, but if you're a MusicBrainz fan, locate the MusicBrainz XML Webservice post. Save either zip file to your hard drive, then extract the .src files inside to the %appdata%\Mp3tag\data\sources folder. The new options can be found under "Tag Sources → MusicBrainz v2."

7 MAKE USE OF ACTIONS

Actions enable you to quickly perform corrections and edits across a range of tracks. For example, if you accidentally leave Caps Lock on while entering tag information, simply select your tracks and choose "Actions → Case Conversion" to apply capitalization to the first letter of each word [Image C]. Select "Actions → Actions" to set up your own or edit an existing action. Actions are organized into groups—this enables you to process



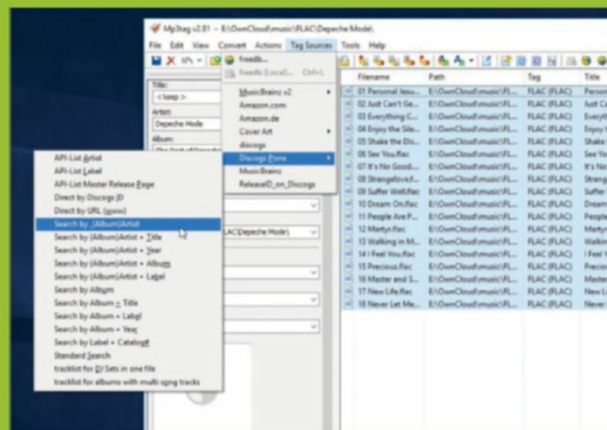
multiple actions with a single click. You can append new actions on to existing actions by selecting the group name, then clicking the "Edit" button followed by "New."

8 ADD A NEW ACTION

Alternatively, create a new action group from scratch: choose "Actions → Actions (quick)" to create a new action and apply it to a new group. This is a wizard-based approach [Image D]. First select the action type—there are 15 templates to choose from—and then select requirements (such as matching text or a regular expression), and the action to perform. To find out how each one works, select "Help → Contents," and click "Actions" in the navigation pane for a comprehensive guide to each template.

9 BACK UP YOUR CHANGES

After a while, you'll build a handy library of third-party or custom-built scripts and actions, as well as tweaking Mp3tag to your personal needs. Protect this by periodically backing up your user configuration—select "File → Save Configuration," and save the zip file to a safe location. When you want to restore it, simply unzip the file's contents to %appdata%\Mp3tag (or the location of your Mp3tag folder, if you're running it as a portable app).



EXPAND MP3TAG'S CAPABILITIES

You'll find lots of scripts on the Mp3tag forum. Browse to <https://forums.mp3tag.de/index.php?showforum=23>, where you'll find one of the best in the form of Discogs (Pone Mod). Follow the instructions to download, extract (use 7zip—www.7-zip.org—for RAR files), and install via the "Actions → Discogs Pone" menu, to reveal a wider range of search options available for Discogs via "Tag Sources → Discogs Pone." Unfortunately,

you may encounter an Oauth error—if this happens, first browse to %appdata%\Mp3tag\data\sources, then open each of the files beginning "Discogs &Pone#" in your text editor, and insert the following immediately below the line beginning "[Encoding]" or, if that doesn't exist, "[SearchBy]":

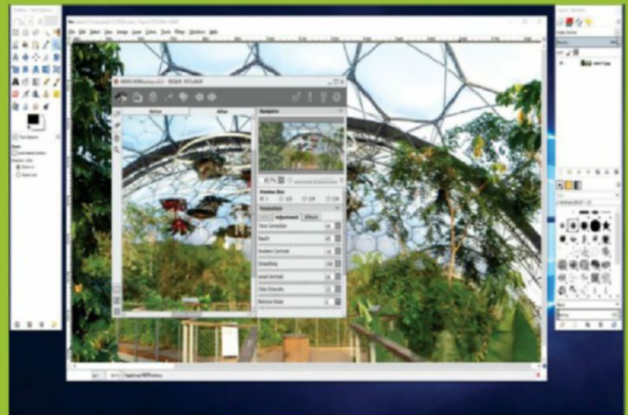
[UserAgent]=1

Save the file, and restart Mp3tag—the problem should now be fixed.

PLUGIN TYPES AND COMPATIBILITY

There are several different types of Photoshop plugins (not including Actions, which are actually macros). Each one works like a mini program, providing extra tools within the host photo editor. 8BF plugins are filter effects, and are the ones you'll be most likely to use, but there are also 8BA (import, or acquisition plugins), 8BE (export plugins), and 8LY (automation plugins). There are also selection plugins in the formats 8BS and 8BY, but none that have been created by third parties.

Generally speaking, the older a plugin is, the more likely it is to work seamlessly with GIMP and other applications. Adobe tightened regulations on developers when it released Photoshop 7, restricting access to the software developer kit (SDK)—including specifications for plugins—and making developer licenses more restrictive. This meant developers often had to choose between ensuring compatibility with other programs and making best use of new features exclusive to Photoshop to give better results.



according to plan, you can use the newly installed plugin just as you would in Photoshop [**Image C**].

» If you want to add more than one plugin, it's best to create multiple folders within the main "Plugins" directory on your desktop. You can then create new reference nodes for each plugin, and easily deactivate any that cause GIMP to become unstable. If a node's indicator button turns red, it means the path is broken—probably because a directory has been deleted or renamed—and any plugins found there will no longer work.

4 OTHER PHOTO EDITORS

If you find GIMP's interface awkward to work with, there are several other photo editors that work with Photoshop plugins. Some of these, such as Corel Paint Shop Pro, are premium software, but are much more affordable than Adobe's app, and potentially a better choice for amateur photographers. These programs usually have a built-in tool for importing and accessing Photoshop plugins, so there's no need for additional tools.

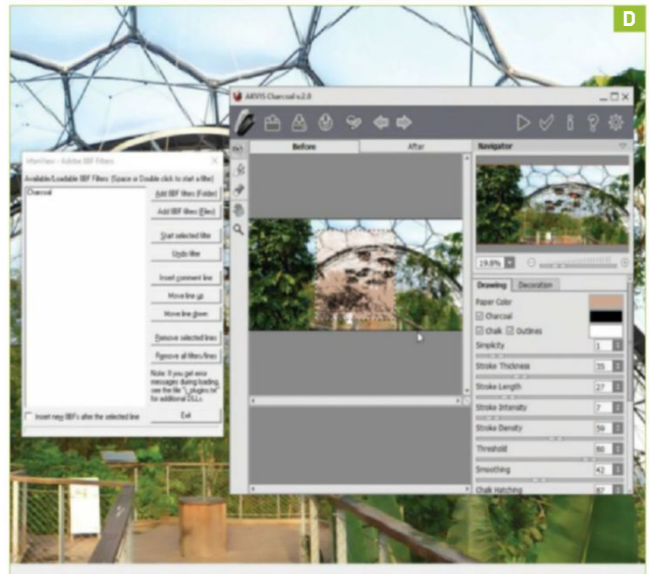
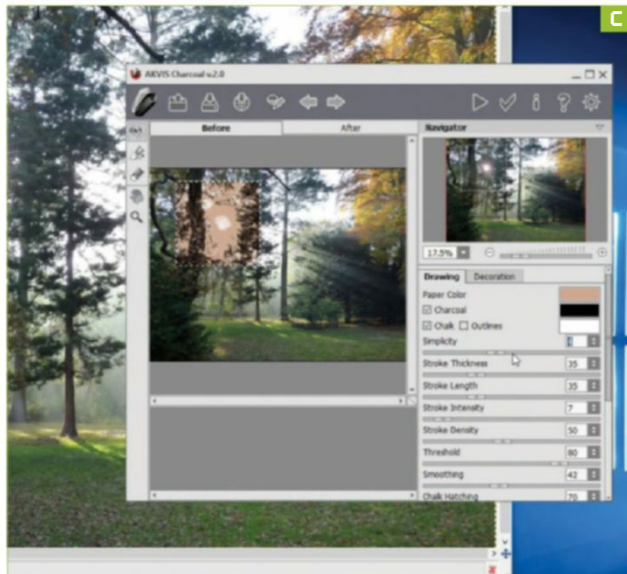
» There are also a few other free editors that are compatible with Photoshop plugins, but are less complex than GIMP, due to being

developed by a smaller team of contributors. One of these is Irfanview—a free photo viewer and organizer that does double-duty as a basic editor.

USE PHOTOSHOP PLUGINS IN IRFANVIEW

If your Photoshop plugin is an 8BF file, it should work with Irfanview. To try it, download Irfanview as a self-extracting exe file from www.irfanview.com/64bit.htm, and run the installer. Once it's finished, download and install Irfanview Plugins from the same location.

» Launch Irfanview, and open a photo to edit. You can open one picture, then browse through the others in the same folder using your mouse wheel. Tap Ctrl-K to access the "Adobe 8BF Filters" dialog, and click "Add 8BF Filters (Files)." Navigate to your downloaded plugin, and click "Open." You can add several plugins this way, and add comment lines to organize them into groups. Click "Start selected filter" to run it as normal. The plugin effect is applied to the whole image once you close the "Adobe 8BF Filters" window [**Image D**].



Play PC Games on Your Smartphone

YOU'LL NEED THIS

REMOTR SERVER

From <http://remotrapp.com>.

SMARTPHONE

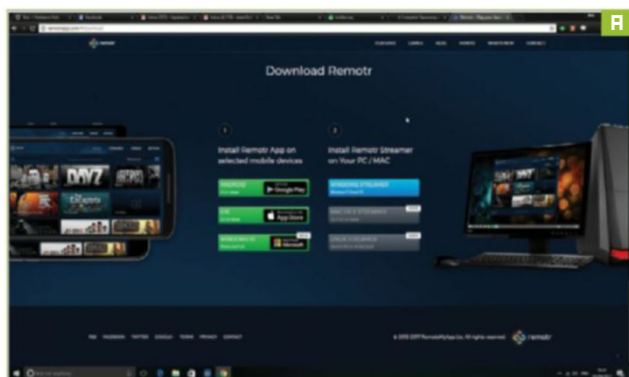
Running iOS 8 or later, or Android 4.1 or later.

CLIENT APPS

Download from your app store.

WE'RE NOT SHORT OF OPTIONS when it comes to streaming games. We've talked plenty in these pages about the immensely useful Steam In-Home Streaming, we've covered the likes of GameShow and XSplit, which send your games up to Twitch and other online streaming services, and we've even looked at ways you can beam console games through your network and play them on your PC. Well, add Remotr to the list. It's immensely flexible, offering up client apps for smartphones, tablets, and other Windows PCs, happily streaming over cell phone networks if you have the data allocation for it, and it's incredibly simple to set up and use.

Let's preface this a little, though, with a couple of caveats. Point one: Don't expect ultra performance or lag-free gaming. Remotr's solution is quick and very well coded, but it's not going to be suitable for the twitchiest games, particularly if you're streaming outside of your local network. It also scales down the quality of streaming (though not the quality of the source game) to meet your network specifications, so if you're obsessed with uncompressed graphical fidelity, you might be best staying at your home PC. —ALEX COX



1 GET THE SERVER

Remotr works on a client/server model, which means you first need to install its server app on your gaming PC. Head to <http://remotrapp.com>, scroll down until you find the relevant option [Image A], and download the Windows Streamer app. Run it to install Remotr, open up the app, and click the "New Account" button to set up an account. You may wish to sign up with a burner email account from the likes of <http://guerrillamail.com> for a couple of reasons: Perhaps you're concerned about getting too much mail from Remotr or its friends (given that there's no option to refuse it), and, if you want to play multiplayer games, everyone's going to need to sign in with the same details.

2 ADD A GAME

Remotr's initial lineup may be a little sparse. It attempts to find games it knows on your hard drive and add them to its interface, and you'll also see a big ad for the affiliated Vortex streaming service, which offers cloud-hosted gaming PCs for a fee. If the game you want to play isn't listed, click "Add Game" in the bottom-left corner, and dig through your hard drive [Image B] to find its executable. Steam games are generally added to the grid automatically, but if they're not, they're usually found in "Program Files (x86)\Steam\steamapps\common." Clicking games in this interface doesn't do anything, but their presence means they're available to any client apps.

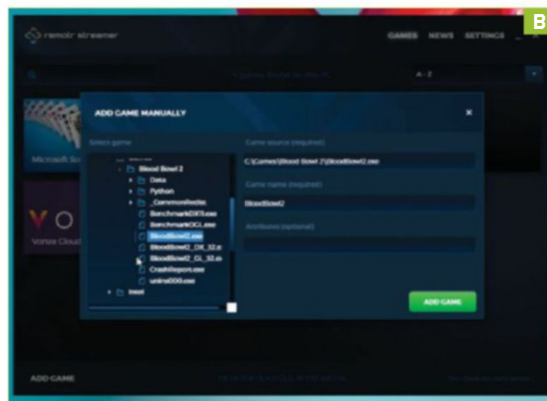
3 GET THE CLIENT

There are two varieties of client available: mobile and desktop. The desktop client is relatively easy, in that you simply need to download and install it, log in with the details we set earlier, and you should see your server active and ready. If you don't, or if the client doesn't seem to be able to connect, make sure your PC is awake—use "Power Options" in the Windows Control Panel to stop it sleeping, if need be—and try bringing the server app into the foreground. You may need to log into Steam, too.

» Installing on mobile is just as straightforward. Find Remotr in your device's app store—it's available for both iOS and Android—and get the app installed. Log in, and you'll see your server; tap it, select a game, and (after you've watched an ad) you should be up and running. If you hit any snags, head to your server, and check the graphics settings for individual games, to ensure they're running in windowed or borderless full-screen mode. In general, proper full-screen mode doesn't play nicely with any kind of streaming or screen capture, and Remotr is no exception.

4 CONFIGURE CONTROLS

Playing on desktop is no trouble, as your controls are translated entirely. If you have a mouse and





keyboard, they work on a PC client exactly as they do on your server machine. Plug in a gamepad, and that should work perfectly, too. On mobile, though, things are a bit different. By default, Remotr uses your phone's screen as a touchpad, translating swipes into mouse movement, and taps into left clicks. It may also, in some cases, presume you'd like to use a gamepad with your target game, and stick an overlay on your screen [Image C]. This can be configured, and any additional controls added to the overlay, by tapping the Remotr icon in the top-right, and selecting "Edit Controls." Thankfully, given that PC games are rarely built to have massive thumbs all over them, you're also free to use Bluetooth controllers or, on Android, wired gamepads with a USB OTG connector. These can be configured in the "Settings" section [Image D].

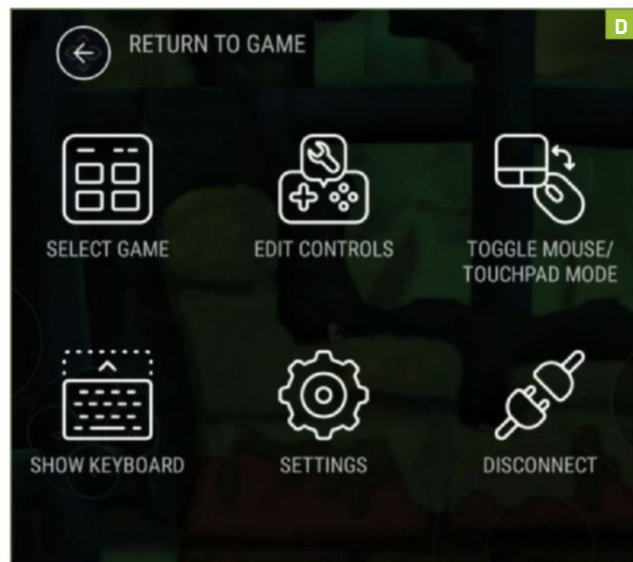
S BETTER SETTINGS

The best results, naturally, come with higher network bandwidth. It's possible to stream over Wi-Fi, though results are unpredictable, and you may experience some input or sound

lag to go with the degraded picture. Hooking your server up to your router via Ethernet is the first step, and using a similar wired client is the second, though this obviously isn't possible if you're blasting games to a mobile device.

» Check the "Settings" screen of the server app, too, for the switch that enables you to activate GPU acceleration. This aids the stream encoding by allowing your GPU to chip in a little processing time, but obviously strips a few cycles away from the game you're trying to run. When streaming, this isn't a huge problem, although you may need to dial back the rendering settings of your games to compensate.

» If you're using a high DPI display, we suggest you drop your screen resolution before streaming, for obvious reasons. There's a switch in the "Settings" screen to automatically drop the resolution when using mobile devices—sending 4K to a 5-inch screen doesn't make a huge amount of sense anyway—but no way to do this automatically when streaming to a PC client. ⚡



PI REMOTE GAMING

If you're looking to send gaming streams to your Raspberry Pi, you may be tired, as we are, of waiting for Remotr's promised Pi app. There is a solution, however, in the form of the decidedly less user-friendly Parsec (<http://parsec.tv>). Using UDP (rather than TCP/IP) to stream at super-low latency, it enables you to install a server on your gaming PC, a client on your Raspberry Pi 3, and beam games from one to the other. There's a slight problem, though: In our experiments, we've found it a little unstable, and somewhat unwilling to work with certain hardware configurations. Theoretically, you should be good to stream even on machines with Intel embedded graphics—your results may vary.

If you have a decent Nvidia card, there's another solution: Moonlight, née Limelight (<http://moonlight-stream.com>), an open-source client for Nvidia's Gamestream protocol. There are versions of Moonlight Embedded, the Pi client, for both Raspbian and Arch, though these are unofficial ports, so we can't vouch for them working perfectly with your particular hardware setup.

Secure Logins with Google Authenticator

YOU'LL NEED THIS LINUX PC

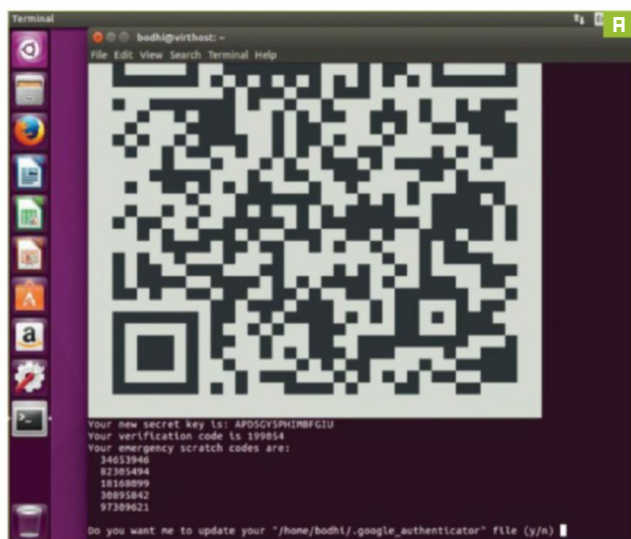
The system you want to secure must be running Ubuntu Linux.

ANDROID PHONE

Your smartphone needs to have the Google Authenticator app.

IN THIS AGE OF MULTI-CORE PROCESSORS and easy-to-use password-cracking tools, locking access to your computer (and all the data it holds) with a password alone simply doesn't cut the mustard anymore. If you're really concerned about unauthorized access to your computer, you should definitely add an additional layer of authentication. One of the easiest mechanisms with which to implement such a two-step verification is the Google Authenticator service, which issues a time-based authentication token to supplement the existing password challenge.

Once you've integrated the service with your Ubuntu login, in addition to your user password, you'll be prompted for one of the quickly expiring tokens before being allowed to log in. Google Authenticator generates these OTPs (one-time passwords) on your Android device once it's been configured for every user on your Ubuntu machine. —MAYANK SHARMA



OPEN SESAME

To implement multi-factor authentication, you need the Google Authenticator PAM (pluggable authentication module). A PAM is a mechanism used to plug different forms of authentication into a Linux computer.

» The Google Authenticator PAM module is available in the official Ubuntu software repositories. To install the package on Ubuntu, head to the Terminal and type:

```
$ sudo apt-get install libpam-google-authenticator
```

» Once the package has been installed, make sure you're logged in as the user you want to protect with the two-factor authentication. Now, in the Terminal window, type:

```
$ google-authenticator
```

» This initiates the process of creating a secret key for the user by asking a bunch of questions. While it's safe to answer yes to them all, it's a good idea to understand each one before making your final choice, as these choices help balance security with ease of use. The first question is pretty safe, and you should allow the command to update your Google Authenticator file by answering yes.

» You're then asked whether you would like to restrict the use of a token, which forces you to wait for 30 seconds between

logins. While it might seem a little inconvenient at first, you should agree to this limitation for maximum protection. The next question asks for permission to increase the time window that tokens can be used for from the default 1:30 minutes to 4:00 minutes. Although you can answer yes to this question to avoid any issues, type "no" for maximum security. If you notice any issues later on, rerun the command, and increase the expiration time as suggested. The fourth and final question asks you to limit the number of attempts for entering the authentication code. You should definitely enable this option, because it helps prevent brute-force login attacks.

2 BOOK OF CODEX

When it's done, Google Authenticator presents you with a secret key and several emergency scratch codes. Make sure that you note down these emergency scratch codes somewhere safe. They'll help you log in if you ever misplace the Android smartphone that generates the OTP. Each code can only be used once.

» The google-authenticator command also generates a QR code [Image A], which you can scan with your Android smartphone. However, because we haven't installed the app on our phone yet, just note down the 16-digit code for the time being.

» Now repeat this process for each user account that uses your computer. Ask everyone you share the computer with to log in to their account, run google-authenticator, and make a note of their respective emergency scratch codes, along with the 16-digit code.

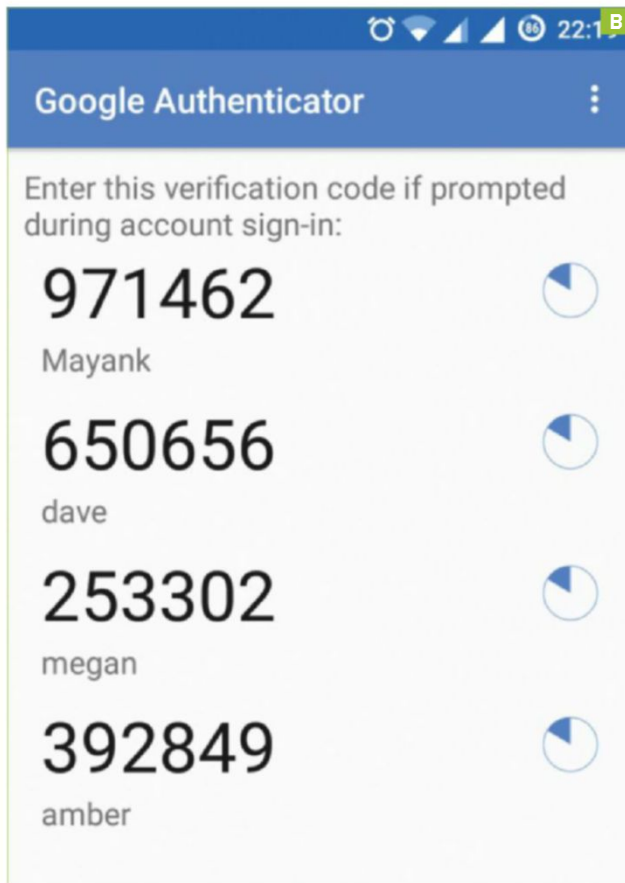
» After you've generated the authentication code for all users, it's time to configure the login process to work with Google Authenticator. All you need to do is edit one file to add two-step authentication for all login attempts. Again, fire up the Terminal, and type:

```
$ sudo nano /etc/pam.d/common-auth
```

Scroll right down to the end of the file, and add the following line:

```
auth required pam_google_authenticator.so nullok
```

» Then save the file and exit. Here we've asked Ubuntu to use the Google Authenticator PAM module for all login attempts. The "nullok" bit at the end of the file asks



Ubuntu to allow a user to log in even if they haven't run the google-authenticator command to set up two-factor authentication. So, let's assume you have two users—amber and megan—and have set up Google Authentication only for amber. Thanks to nullok, while amber has to enter the OTP to access the system, megan can log in with just her password.

» Note, however, that while this is a useful flexibility to have while you're testing Google Authenticator, once everything works smoothly, and you have no issues logging in with the two-factor authentication, it's advisable to force all users to log in through Google Authenticator—you do this simply by removing the "nullok" bit for this command.

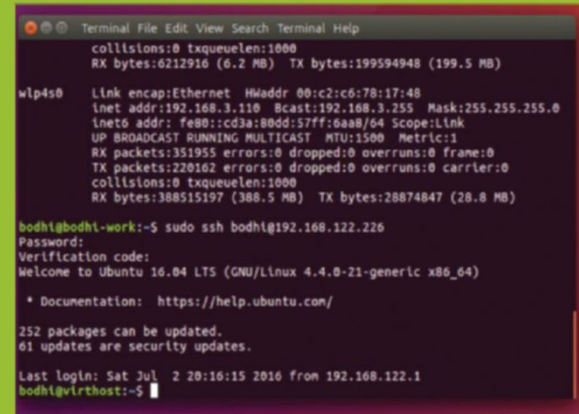
3 GO GO GADGET

Your Ubuntu installation is now all set up for two-factor authentication. To receive the OTPs, you now have to install the Google Authenticator app from the Google Play Store on your Android smartphone. After installing the app, you have to add an account for all the users you've run the google-authenticator command for on your Ubuntu installation [Image B].

» To do this, open the app, and from the main window, tap the menu button (the three vertical dots in the upper-right corner). Here, tap "Set up account," and then select the "Enter key provided" option. Now enter the 16-digit secret key that you noted earlier, after you had run through the google-authenticator tool. Give the account a name (a good idea is to use the username of the account this is for), and tap the "Add" button.

» You've now set up two-factor authentication on your computer. The Android app generates a new six-digit code every 30 seconds. When you log in to your account or enter a sudo command, Ubuntu prompts for your password, and you're then asked to enter the

SECURE SSH WITH GOOGLE AUTHENTICATOR



Instead of local logins, some people prefer to enable two-factor authentication only for remote SSH logins. For this, begin by making sure you've generated a code for the user you want to log in as a remote user. Next, make sure you use Google Authenticator for SSH logins by editing SSH's PAM configuration file with `sudo nano /etc/pam.d/sshd`. Scroll down to the bottom, and add the following line to the file:

```
auth required pam_google_authenticator.so nullok
```

As in the main tutorial, the "nullok" word at the end tells PAM that this authentication method is optional. This allows users without a Google Authenticator key to still log in using their SSH key. Remember that this is just a fail-safe to prevent you from being locked out, in case something goes wrong with the setup process. However, once you have tested it successfully, generate a key for all SSH users, and delete "nullok" from the end of this line to make logins via OTP mandatory for everyone.

After editing SSH's PAM file, it's time to configure SSH to support this kind of authentication. Open the SSH configuration file with `sudo nano /etc/ssh/sshd_config`. Look for the line that reads "ChallengeResponseAuthentication," and set its value to "yes." If the line doesn't exist, add it manually. Save and close the file, then restart SSH to reload the configuration files with `sudo service ssh restart`. You're now prompted for both your password and Google Authenticator code whenever you attempt to log in via SSH.

authentication code. At this point, enter the digits currently on display in the Android app.

» Once you've logged in successfully, make sure you edit the "etc/pam.d/common-auth" file, and remove the "nullok" option, to force login through Google Authenticator. Also, remember to create an account in the Android app for all the users on your Ubuntu installation.

» Going through the additional security might seem like a hassle, especially when you need to switch to sudo to quickly edit a configuration file. But if you're using the computer in a public place, you'll quickly learn to appreciate the benefits of two-factor authentication. 🔒

ZAK STOREY, REVIEWS EDITOR



LEVEL OF DIFFICULTY: **EASY**

A black NZXT computer case with a transparent side panel. The case is shown from a three-quarter view, highlighting its sleek, angular design. The transparent panel reveals the internal components, including a large blue fan with a mesh grille, a GeForce GTX graphics card with green LED lighting, and various cables. The NZXT logo is visible on the bottom left of the transparent panel. The case is set against a plain white background.

THE PRETTIEST OF SYSTEMS

WHEN SPECING THIS BUILD, it was less about hitting those performance and pricing sweet spots, and more about what looked good. We decided to go with a simple, sleek, black and white build, with a few old parts showing their faces once again.

The case is connected to July 2016's liquid-cooled build. If you remember, we asked NZXT to send us two of its fantastic Manta cases. Using the interior of the black variant with the exterior white panels added real pop, and helped ensure that the white coolant wouldn't be lost. This is the reverse. With a white interior and black panels, it works really well as an AIO build, and the black cables of the Kraken X52 stand out against the white inside.

You might also spot some other parts from that feature: the Asus Z170i Pro Gaming, with custom black plastidipped heatsinks, and the Corsair AX1200i PSU, with its custom sleeved white cable kit from CableMod.

That, however, is where the similarities end. Instead of 32GB (2x 16GB) of Kingston HyperX DDR4 at 2,666, we decided to go with G.Skill's stunning Trident Z at 3,200. We also made good use of NZXT's latest Kraken X42, to really make the central CPU focal point pop—that focal point being a Core i5-6600K (because, honestly, GHz is just a number, right Kaby Lake?). And how could we forget the world's most powerful GPU, the power-hungry, frame-spitting GTX 1080 Ti, sitting center stage?

INGREDIENTS

PART		STREET PRICE
Case	NZXT Manta	\$120
Motherboard	Asus Z170i Pro Gaming	\$152
CPU	Intel Core i5-6600K	\$240
Memory	32GB (2x 16GB) G.Skill Trident Z DDR4 @ 3,200	\$322
GPU	Nvidia GeForce GTX 1080 Ti Founder's Edition	\$689
PSU	Corsair AX1200i + White CableMod Kit	\$290 + \$120
Storage	OCZ Trion 150 960GB	\$237
Cooling	NZXT Kraken X42 + 3x Be Quiet! Silent Wings 3 High Speed PWM 120mm	\$125 + \$56
OS	Microsoft Windows 10 Home	\$100
Total		\$2,451

1

FRONT FAN COVERS

THE COOLING SETUP for this system was done quickly and on the fly. Ideally, we would have loved to have included a Kraken X52 or X62 here (the 240/280mm versions), but because the X52 is currently off-site, and the X62 is doing service as part of our dedicated test bench, the X42 was our next port of call. Its single 140mm rad should keep the CPU well in check, but it does provide some conundrums as to where to mount it. In the end, to keep the interior looking clean, we anchored it to the front panel, behind this fan filter, with the included NZXT stock fan, drawing air through the radiator and into the case.



2

POSITIVE POWAH!

TO OFFSET THE LACK of internal airflow being drawn in via the front of the case, we decided to install two Be Quiet! Silent Wings PWM 120mm fans directly into the roof, drawing air down into the chassis. Now, thanks to the Manta's expansive roof space, you could actually install these on top of the case, but to improve airflow, and get some of the moving parts viewable inside the system, we opted to have them mounted below instead. Another perk of the radiator being a single 140mm in the front.



3

LED LOGOS AND PSU WOES

ANOTHER NEAT PERK of one of our favorite ITX cases is the inclusion of this simple NZXT LED logo. No RGB, no frills, a couple of on/off settings, and that's it—controllable via a button located near the rear I/O panel at the back of the case. On top of that, you also get to see the mighty Corsair AX1200i modular Platinum PSU. It's a fairly chunky PSU, but the Manta has more than enough room for the brute. We grabbed our set of custom braided CableMod cables for this system, too, because the white matches the build perfectly. However, after seeing some of the company's new cable combs recently, we do wish we'd had a set for that build way back when. But more to come of that in the next two issues....



5

FAN CONTROLLER FUN

THERE'S A REASON this isn't a wide shot of all the cables: because it's nowhere near even close to being tidy. In fact, the cable ties used to jerry-rig this system together weren't even cut off until after the video was shot, during our own personal photo shoot. That fan controller, though—we can't express enough how useful these things are. Simply plug in six or seven fans of your choosing (DC or PWM), run one SATA power into it, connect one PWM header directly to your motherboard, and you can control them all off a single fan profile in PWM mode. Neat.



4

STORAGE SOLVED

WHAT, NO SSDS? OK, once again, this was due to time constraints. The original plan was to use two Samsung 850 Evos for the show build (admittedly, one was 250 and the other 500GB). However, because of how NZXT has positioned the cable cutouts for these mounts, there's only one way to attach the drives, and that would mean the Samsung logo would end up being upside down. Less than ideal. So, we dropped them entirely, and ran a single OCZ Trion 150 960GB instead, hidden behind that PSU cover on the bottom. The only criticism, looking back, is that perhaps we should have removed the two trays.



6

I/O LED AND MANTA TRAUMA

ANOTHER SHINY ADDITION to the Manta is the inclusion of this rear I/O LED light, ideal for those fumbling around in the dark or under desks. Again, controllable thanks to a tiny little switch located just above it. The only problem? Well, the video team managed to place the system back in the box the wrong way round, wedging it and the packaging inside its box. And when we last placed it back in the box during our photo shoot, having to drop it into place, the LED cover for the rear I/O unfortunately got caught on this reviewer's arm, and snapped off.





- 1 The new Kraken CPU coolers have always looked good—but, boy, are they irritating! Why? Cables, cables everywhere.
- 2 Plastidip is a good insulating material. Fortunately, your VRMs and chipset don't actually get hot enough for it to have any effect.
- 3 The back of the Z170i Pro Gaming features a neat M.2 PCIe x4 slot for all your NVMe-capable devices.
- 4 Which is useful, because of how few accessible SATA ports there are for a clean build.

THE CLASSY CONQUEROR

WE COULD HAVE GIVEN this build a funky *Warhammer 40K* name, such as the Emperor's Chosen, or Gabriel Ti-gelous. But that's not our style, and the Classy Conqueror fits the bill a hell of a lot better. After all, this is a system that any PC enthusiast could be proud of.

Building a rig at such short notice threw up a lot of challenges. Usually, we spend an hour or two planning each build, requesting the parts, then piecing it together however we see fit. Having to improvise and make decisions on the fly, however, turned out to be far more satisfying than we thought. The Kraken X42 forced us to rethink our cooling strategy: Instead of having two intakes in the front, two exhausts in the roof, and leaving the rear blank, we opted to run three intakes top and front, and one exhaust running out the rear.

We also chose to use a BitFenix Alchemy 30cm LED white strip along the top, to illuminate the interior, pulling light straight down on to the GPU, CPU, and memory. It looks stellar, glinting off the braided tubes connected to the AIO. That said, it was actually an older, used adhesive LED strip, and toward the end of the build, it repeatedly fell off, even with a brand new layer of double-sided tape. Solution? Cable-tie it. It's held in place by three cable ties, through the unused 140mm fan mounts at the top of the chassis. We also only used two screws in each fan, to save time, even if it was only seconds in reality.

What about performance? Well, it's a weird one—with Ryzen dropping, and the 1600 and 1600X coming in at Core i5 prices, it's hard to say that this system actually represents

respectable processor performance. Single-core performance is identical to team red's, but multicore is a bloodbath: 606 points in Cinebench R15—hardly anything worth writing home about. That said, there currently aren't any ITX Ryzen boards worth investing in, and the game difference can be staggering in some instances. Speaking of games, the GTX 1080 Ti really does push the limits when it comes to our benchmark suite, smashing all of the 1080p tests with ease. The lowest, *Deus Ex*—a title notorious for both its poor Nvidia optimization and ridiculously aggressive antialiasing at x8 MSAA—came in at 29fps. Otherwise, it was an easy 60fps sweep across the board, with an average of 92 frames per

second in *Rise of the Tomb Raider*, and 106 in *Far Cry Primal*.

That said, this rig shines in both high refresh 1440p and 4K gaming. We're not quite at 60fps with the AA ramped up just yet, but if you drop those AA tendencies down a tad, it's not difficult to hit that 60fps sweet spot.

When all's said and done, this build was a pleasure to produce, and a very proud moment for this reviewer, seeing it going out live in the *Dawn of War III* campaign. It looks a treat, and would be at home on any enthusiast's desk. Drop down to some more suitable memory, a Z270 Strix ITX board, a lower-end PSU, and a reference GTX 1070, and you'd be looking at a very graceful 1440p gaming machine. 🕹

BENCHMARKS

	ZERO-POINT	
Cinebench R15 Multi-Thread	987	606 (-39%)
Cinebench R15 Single-Thread	196	151 (-22%)
CrystalDisk QD32 Sequential Read (MB/s)	1,895	534 (-72%)
CrystalDisk QD32 Sequential Write (MB/s)	949	520 (-45%)
Rise of the Tomb Raider (fps)	76	92 (21%)
Far Cry Primal (fps)	72	106 (47%)
Attila: Total War (fps)	42	52 (24%)
The Division (fps)	73	127 (74%)

Our desktop zero-point PC uses a Core i7-6700K CPU @ 4.6GHz, an AMD R9 Fury X, and 32GB of RAM. All games are tested at 1080p on max settings, with HD texture packages installed.

Get the world's best Linux magazine

**OUT
NOW!**



DELIVERED DIRECT TO YOUR DOOR

Order online at www.myfavouritemagazines.com

or find us in your nearest supermarket, newsagent or bookstore!

REVIEWS

TESTED. REVIEWED. VERDICTIZED.

DELL
XPS 15
PAGE 84

INSIDE

- 78 Sapphire Radeon RX 580 Nitro+
- 80 AMD Ryzen 5 1600X
- 82 Corsair One Pro
- 84 Dell XPS 15
- 86 Cooler Master MasterPulse
- 87 ID-Cooling Frostflow 240L
- 88 Asus ROG Gladius II
- 89 Ashampoo Backup Pro 11
- 90 Mass Effect Andromeda
- 91 Dead Rising 4
- 92 Lab Notes



It may be a new card,
but it's an old GPU.

Sapphire Radeon RX 580 Nitro+

Revamped, reclocked, rebadged

OH AMD, AMD, AMD. Why do you do this to us? You fight, and you riot, and you revolutionize the processor industry, then you tease us with a brand new graphics card, only for it to be little more than a rebadge. Let's cut straight to it: This is not a brand new architecture. In fact, there's very little new about the Radeon RX 580 at all. The launch of this new GPU came with little fanfare, and with good reason: It's not Vega.

In short, moving from the RX 480 to the 580 provides nothing more than a slight overclock to the base card. Indeed, you could achieve the same results by bumping up the power target to 110 percent, and moving that clock frequency slightly higher. So why do it? Good question. In short, we can only guess it's down to improvements in the manufacturing process. Rumors abound—we know that GlobalFoundries (the crew that manufactures AMD's GPUs and CPUs) uses Samsung's 14nm LPE (standing for low power early, this is Samsung's second iteration on its 14nm manufacturing process) technology in its 400 series cards. It's possible that with the RX 500 series, GloFo is using Samsung's (newly announced) 14nm LPU tech instead, improving power efficiency and clock speeds in the process. Which may explain

the additional 30W TDP included on this card, and the slightly higher clocks.

That aside, it's the nomenclature that gets us. Traditionally, with every new series of cards, you get one or two rebadges. For instance, a 380 becomes a 470, a 370 becomes a 460, and so on. Dropping the price point, and improving power efficiency in the process, is great for the consumer, because cards with substantial performance, coming in at an incredible cost, suddenly become more affordable.

The 580, on the other hand, has missed that beat. The RX 480 has migrated across to the 580. This would make sense if AMD were about to embark upon a new naming scheme, or even if it were to launch two new flagships with these rebadges, but that's simply not the case. So what's going on? If anything, these two cards should have been renamed the 485 and the 475. Especially when you include the lack of any reference variants.

Right, enough grumbling, how does it look from a performance perspective? Well, we have to make it clear that our RX 580 sample was the Sapphire Nitro+ pre-overclocked version, compared to our stock RX 480. Generally speaking, in game we saw an increase of around 10 percent

across our titles at 1080p. Going from 61fps in *Far Cry Primal* to 66fps, 58fps to 67fps in *The Division*, and 34fps to 40fps in *Rise of the Tomb Raider*. Fairly impressive for a GPU that is essentially just a rehash.

Who is this card aimed at? In short, anyone who still hasn't upgraded from AMD's R9 300 series, or the lower end of Nvidia's GTX 900 series. It's a rehash of an already well-manufactured, well-priced graphics architecture, bringing that price-to-performance heritage forward into 2017. In fact, price-to-performance-wise, it's actually in a bit of a sweet spot. It doesn't quite wipe Nvidia's GTX 1060 3GB off the top of the 1080p hill just yet, but it's close. And with that extra performance? It's damn tempting, to say the least. Couple it with a decent FreeSync 1080p monitor, and you'll be on to a winner.

There's been no official announcement from AMD yet as to when Vega may be launching, although rumors abound that it could be any time within the next few months. In fact, by the time you read this, Computex should be over, and those rumors will hopefully become fact. Until then, you might want to hold off on those big GPU splurges. —ZAK STOREY



Sapphire Radeon RX 580 Nitro+

■ **VEGA** Solid performance at 1080p; impressive value for cash; quiet and cool; clean design.

■ **NOT VEGA** It's not Vega; renaming scheme is nonsense; can be achieved on an RX 480 with overclocking.

\$250, www.sapphire.com

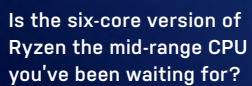
BENCHMARKS

	Sapphire Radeon RX 580 Nitro+	AMD Radeon RX 480	EVGA GeForce GTX 1060 3GB SC
Total War: Attila (fps)	28/36	21/30	24/36
Far Cry Primal (fps)	52/66	48/61	49/61
The Division (fps)	42/67	34/58	31/55
Rise of the Tomb Raider (fps)	12/40	11/34	9/35
3DMark Fire Strike (Index)	12,044	10,542	10,251
3DMark Time Spy DX12 (Index)	4,515	3,979	3,905

Best scores are in bold. Our test bed consists of an Intel Core i7-7700K, 16GB of Corsair DDR4 @ 2,400, an Asus Maximus IX Hero, and a 500GB Samsung 850 Evo SSD. All games are tested at their highest graphical profile, with AA turned up, at 1080p.

SPECIFICATIONS

GPU	Polaris
Lithography	14nm FinFET
Transistor Count	5.7 billion
Stream Processors	2,304
Texture Units	144
ROPs	32
Core/Boost Clock	1,340/1,411MHz
Memory Capacity & Type	8GB GDDR5
Memory Bus	256-bit
TDP	185W
Display Connectors	DisplayPort 1.4, HDMI 2.0b, DVI-D



AMD Ryzen 5 1600X

Taking AMD's new hexa-core hotness for a spin

WHEN AMD PULLED the wraps off its radical new Ryzen CPU, it was all about those eight awesome cores. Count 'em, Intel. The first Ryzen 7 chips blew the market for \$300-plus CPUs wide open. But not everybody can unload that kind of money on a processor, especially a brand new design that also requires a motherboard upgrade. Enter the Ryzen 5 1600X. On paper, it might just be the ultimate balancing act between performance bang and efficient deployment of your hard-earned buck.

Try this for a compelling proposition. The 1600X packs six cores, and supports 12 software threads, while a similarly-priced Intel processor, the Core i5-7600K, has four cores and just four threads. And as a consequence of being the top six-core model, it also clocks in at 3.6GHz nominal and 4.0GHz turbo. In other words, it looks like a very nicely balanced chip. Plenty of cores and threads for powerful parallelism, plus high clocks to provide solid single-threaded performance. And all for \$249. It's the mid-range CPU that we've all been waiting for, right?

For the most part, that's an affirmative. When it comes to outright multithreaded performance, it pops a cap in the head of the Intel Core i5. Take Cinebench: The Core i5-7600K manages 663 points. The Ryzen 1600X? A massive 1,223 points, or nearly double the Core i5's capability. As you-know-who would say, that's 'uge.

Admittedly, the Core i5 retains some dignity in the single-threaded version of

Cinebench, with 179 points compared to the 1600X's 159 points. However, the AMD chip looks like the better trade-off at first glance. Elsewhere, if the results aren't quite so spectacular, AMD still chalks up some decent wins. It crunches high-quality video encoding at 22fps to the i5's 16fps, and it motors through the Fry Render benchmark in just 3 minutes and 46 seconds—that's fully two minutes faster than the 7600K.

PARALLEL LINES

Put simply, if you want a CPU for content creation, or really any workload that majors on parallelism, this isn't even a race. The Intel competition is hideously, hopelessly outclassed. That's true even taking into account the fact that the Ryzen CPU is a little more power-hungry. An extra 10 watts at the wall is surely worth it.

Where the Ryzen proposition is a little less compelling is in the games arena. It looks competitive in our benchmark numbers—when it comes to average frame rates, the 1600X delivers on that 40Hz promise. The subjective experience, however, tells a slightly different story. *Total War: Attila* is a great case study here. Running on the Intel processor, it's super-smooth, whether you're up in the sky, lording it over your troops, or down in the thick of the action. But with the Ryzen CPU at the same settings and using the same video card, there's noticeable judder almost everywhere. It's not nearly as

smooth, and the difference is far greater than the modest average frame rate gap.

As for the reasons why, there are numerous candidates. For starters, we used an Nvidia GPU, and there are at least indications that the Nvidia driver is poorly optimized for the Ryzen architecture. There are also question marks surrounding Ryzen's basic architecture, which is composed of a pair of quad-core modules. Long story short, some latency is involved in communicating between the two quad-core modules, and that can require careful management by both OS and application to avoid performance penalties. Ryzen is brand new, so most software has yet to be tweaked to take account of such issues.

Of course, most software runs OK without any modifications. It's just a pity that the main class of application that seems to be particularly sensitive to Ryzen's architectural nuances just so happens to be gaming. On a final note, like other Ryzen processors, the 1600X has pretty much zero overclocking headroom. AMD has these things running pretty ragged. An additional 100MHz was the best we could achieve. —JEREMY LAIRD



AMD Ryzen 5 1600X

NEW HORYZEN Mega multithreading performance; fantastic price; great stock clock speeds.

SUNDOWNER Patchy gaming performance; little to no overclocking headroom.

\$249, www.amd.com

BENCHMARKS

	Ryzen 5 1600X	Intel Core i5-7600K
X265 (fps)	22.18	15.86
Cinebench R15 Single (Index)	159	179
Cinebench R15 Multi (Index)	1,223	663
Fry Render (m:s)	3:46	5:46
Power Draw Idle (Watts)	45	44
Power Draw Load (Watts)	115	103
Total War: Attila (fps)	36	40
Far Cry Primal (fps)	74	77
Rise of the Tomb Raider (fps)	43	43
Deus Ex: Mankind Divided (fps)	13	13

Best scores are in bold. Our test bed consists of an Asus Crosshair VI Hero, 16GB of Corsair Vengeance LPX DDR4, and a GeForce GTX 1080. Games are tested at 1440p on the highest graphical profile, with MSAA enabled.

SPECIFICATIONS

Base Clock	3.6GHz
Turbo Clock	4.0GHz
Cores	6
Threads	12
Lithography	14nm FinFET
Cache	16MB L3
Memory Support	DDR4-2666
Memory Channels	2
PCIe Lanes	16 + 4
TDP	95W



Not a trash can.

Corsair One Pro

System integrator Corsair. Wait—what?

CORSAIR HAS LONG BEEN a trusted brand in the PC building world, known for its quality and high-end components and peripherals. If you've built a PC in the last two decades, it's likely you've used at least one Corsair product. But, until recently, the company hadn't jumped into offering complete, pre-built systems in the same way as the likes of MSI, Asus, and Gigabyte do.

With the One, Corsair has clearly established itself as a true pre-built system manufacturer, setting itself up with a strong foundation in this machine. It's a triumph of clean design, excellent performance, and small-form-factor engineering. Measuring 7.9 x 6.9 x 14.9 inches, the One stands only a few inches taller than a Mac Pro, but has a look that's more reminiscent of *Tron* than the Mac Pro's glorified dustbin appearance.

One of the more impressive features is its cooling solution. Both the CPU and GPU are cooled by their own individual 240mm radiator each. But rather than outfitting each of those with their own fans, the entire system is cooled by a single 140mm maglev fan up top that through convection, draws cold air in through the radiators and exhausts it out the top. The result is a well-cooled system with a minimal footprint that runs whisper quiet.

The overall design is impressively compact. There's no doubt that you could build and even buy Mini-ITX systems that are smaller than this beast, but Corsair utilizes every internal square inch of the One to full effect. There's no wasted space,

and no add-ons just for the sake of having frills. The One takes the best that Corsair has to offer, and distills things down into a very svelte machine. And did we mention it's powerful?

PACKAGE OF POWER

Packed inside is an Intel Core i7 processor, an Nvidia 10-series GPU, as well as plenty of storage, varying by tier—the One starts at \$1,800 for an i7-7700, GTX 1070, 240GB SSD and 1TB HDD, and goes up from there. The "Pro" unit we tested featured an i7-7700K, GTX 1080, and 960GB SSD, for a retail price of \$2,300.

The Corsair One punches out some serious performance, too, hot on the heels of much larger, beefier systems. Gaming performance fell short of setups with dual-GPU loadouts, but the One's single GTX 1080 beat almost all of the other single-card systems we've tested in the last year, losing out to a GTX Titan X machine we tested late in 2016.

The Corsair One more than delivers on the promise of excellent gaming performance in a small package. Even better, it does so without relying on large, loud fans to keep everything cool. For most small form factor systems, heat management is often their Achilles' heel. Not so with the One: Performance remained stable even after running our high-load benchmarks simultaneously.

Of course, pre-built systems are well known for adding a small price premium

over the cost of building the rig yourself. However, if you add together the individual cost of everything packed inside the One, you reach a price not much cheaper than the cost of the complete system, especially when you add in Windows and the time it takes to build it. Either way, Corsair brings a lot to the table here. For one, small form factor systems are especially tough to build inside, and the innards of the One are manicured with precision. Similarly, the One's custom chassis isn't the kind of thing you can easily recreate yourself. There's also the added benefit of a manufacturer's warranty—the One comes with two years of parts and labor covered. But, most of all, it's the ease of having a plug-and-play gaming system that looks great and performs even better—and, for some, that's priceless.

The One is nothing short of a major milestone for Corsair. Having made components and accessories for decades, the company is now in a position to fuse all of its strengths together into one beautifully designed tower of power. **—BO MOORE**



Corsair One Pro

#1 Excellent gaming performance; sleek design; small and quiet.

2 Difficult to access

the interior.

\$2,300, www.corsair.com

BENCHMARKS

	ZERO-POINT	
Cinebench R15 (Index)	987	970 [-2%]
Tech ARP x264 (fps)	21.93	21.75 [-1%]
PCMark 8 Creative (Index)	7,675	8,732 [14%]
CrystalDiskMark 4K Read (MB/s)	54.85	38.25 [-30%]
CrystalDiskMark 4K Write (MB/s)	171	128.5 [-25%]
Far Cry Primal (fps)	76	108 [42%]
The Division (fps)	78	104 [33%]
3DMark Fire Strike (Index)	15,026	17,997 [20%]

Our desktop zero-point consists of a Core i7-6700K overclocked to 4.6GHz, an XFX Radeon R9 Fury X, 32GB of Kingston HyperX Savage DDR4-2400, and a 256GB Samsung 950 Pro, mounted on an Asus Z170i Pro Gaming.

SPECIFICATIONS

Processor	Core i7-7700K
Graphics	MSI GeForce GTX 1080
RAM	16GB (2x 8GB) Corsair Vengeance LPX @ 2,400MT/s
Motherboard	MSI Z270i Growler
Primary Storage	960GB SSD
Additional Storage	None
Cooling Solution	2x 240mm AIO liquid coolers, 1x Corsair ML140
PSU	Corsair SFX 650W 80 Plus Gold
Case	Corsair One
Warranty	Two-year parts and labor



As good as 15-inch PC notebooks currently get?

Dell XPS 15

Dell ups its XPS ante once more

AS THE 500LB GORILLA of PC manufacturing, Dell can be a bit of a clumsy, lumbering corporate brute on occasion. But all that muscle does occasionally allow it to punch a little harder than the competition.

Enter the newly revised XPS 15 notebook system, the latest in a proud line of high-end, full-feature laptops from Dell. Immediately, it socks you squarely in the eyes with that gorgeous Infinity Edge display. It's 15.6 inches in diagonal, but thanks to the vanishingly compact proportions of the bezels, the XPS is the smallest such laptop on the market. In other words, slim bezels don't just look great, they have a practical benefit, too.

The screen is also utterly gorgeous to look at, thanks to IGZO IPS panel technology, and a full 4K pixel grid—that's 3,840x2,160 pixels. What's more, Dell claims the new XPS 15 with this 4K screen option is also the only laptop to support 100 percent of the Adobe RGB color space. Graphics pros will love this screen.

If there is an issue with the display, it involves scaling. For starters, Windows simply doesn't scale DPI settings terribly well, even now. Nor, for that matter, does much of the web, which often still relies on bitmaps, and isn't particularly DPI-aware. None of that has anything to do with Dell or the panel's implementation—however, what Dell might be able to address is non-native resolution scaling. The 4K pixel grid is precisely four times that of 1080p, so a simple pixel-doubling scaling option would

allow the screen to have, in effect, two native resolutions. For gaming, that would be a huge boon. Instead, the XPS relies on standard non-native scaling, which slightly softens and blurs the image. Hold that thought.

Elsewhere, the XPS impresses with slick and solid design and engineering, thanks to metal top and bottom covers, and a very sturdy keyboard. The screen, incidentally, is also covered in Corning Gorilla Glass NBT for top-notch scratch resistance. While we're talking physical attributes, the XPS's power supply is pleasingly compact for what is a fairly powerful PC. Overall, the XPS 15, as a physical object, is about as good as PC notebooks get for perceived quality and material gorgeousness, even if it can't quite match Apple's ridiculously well-finished portables by those metrics.

BED OF ROSES?

But what of performance? You wouldn't kick it out of bed, that's for sure. Performance from the quad-core, eight-thread Core i7 Intel chip is very much a known quantity, and probably as much raw CPU horsepower as all but the most demanding content-creation professional would require. The PCIe solid-state drive is another strong addition. It wasn't all that long ago that storage was the weak link in a portable PC. Now, thanks to the latest NVMe storage tech, this XPS cranks out 4K random access performance that only the latest and very greatest desktop PCs could

match. As for raw sequential throughput, we're talking GB/s. It's hella quick.

What isn't so speedy is the Nvidia GeForce GTX 1050 graphics. Praise be—Nvidia's naming for mobile GPUs now lines up with its desktop parts. So, this is a real 1050 GPU. But it's also as lowly as Nvidia's new Pascal graphics family gets. The upshot is what we'd characterize broadly as decent mobile gaming performance at 1080p, depending on the title in question, and the settings you choose.

This is where that scaling issue we mentioned comes in. Admittedly, the XPS scales non-native resolutions as well as any system we've seen, but with true pixel doubling at 1080p, it would be as crisp as a native 1080p panel, and that would make for a much better match with the Nvidia 1050 GPU. It doesn't even nearly have the grunt to drive the panel at native 4K, that's for sure. It's really the only demerit in a very strong overall package, which also includes reasonable battery life for this class of system of over six hours of HD video playback. —JEREMY LAIRD

VERDICT
9

Dell XPS 15

TO INFINITY! Awesome Infinity Edge display; great all-round performance; quality chassis.

BUT NOT BEYOND Graphics performance merely reasonable; pricing is painful.

\$2,499, www.dell.com

BENCHMARKS

	ZERO-POINT	
X264	682	736 (7.92%)
Cinebench R15 (Index)	15.17	15.7 (3.49%)
CrystalDiskMark 4K Read (MB/s)	44.2	59.9 (35.52%)
CrystalDiskMark 4K Write (MB/s)	162.1	180.4 (11.29%)
Battery Life	153	393 (156.86%)
Rise of the Tomb Raider (fps)	42.3	33 (-21.99%)
3DMark Fire Strike (Index)	6,583	5,548 (-15.72%)

Our laptop zero-point is the Asus G752VT-DH72, with an Intel Core i7-6700HQ, GTX 970M, and 16GB of DDR4. Rise of the Tomb Raider tested at very high settings, with SMAA at 1080p.

SPECIFICATIONS

Processor	Intel Core i7-7700HQ
Graphics	Nvidia GeForce GTX 1050 4GB
RAM	32GB DDR4
Resolution	3840x2160
Display	15.6-inch IGZO IPS
Storage	Samsung PM961 1TB NVMe SSD
Connectivity	2x USB 3.0, 1x USB C, HDMI, SD card reader
Dimensions	14.06 x 9.27 x 0.45–0.66 inches
Weight	4.5lb
Warranty	One-year mail

Cooler Master MasterPulse

Comfy convertible cans

WE GENERALLY DON'T USE extended theme park analogies to describe PC peripherals, but rarely has a headset ever taken us on a rollercoaster ride like this one did. We started sweating in the queue. The MasterPulse's prime gimmick, a set of neodymium-magnet mounted plates, which click on to the outside of each ear cup, is a new experience. Properly installed, the plates infer a closed back design; removed, the headset converts to a semi-open configuration, and activates Cooler Master's Bass FX tech for a far fatter sound. Two distinct sounds in one headset, with a completely analog way of converting from one to the other. Either this is a feat of audio engineering, or something we really don't want to be riding.

And so we strap in. Cooler Master has definitely got the construction right—getting the MasterPulse nestled on your skull is a highly pleasant experience. The ear pads are generous, soft, and easily encompass the biggest ears and the oddest-shaped skulls, despite the stiff, fixed construction of the headband. Floating padding, with five individual squishy nodules, does a great job of securing the headset to your scalp without any noticeable pressure, and the lightweight aluminum construction only helps long wearing. The only way these aren't going to sit comfortably is if you favor the half-on, half-off configuration—popular in the prank-filled *Maximum PC* office, because the isolation of full cans does a number on one's ability to hear ongoing shenanigans—in which case, the tightness of the headband is going to crush your ear cartilage. An edge case, but one to be aware of.

CABLE GUY

We should mention the cable at this point, which is a little disappointing. Not for its in-line mic and analog volume control, although relegating the mic to a tiny pin-prick on the top of the cable module does, for all the acceptable quality of voice capture, make it seem like a massive afterthought. And not for its color—a pleasing deep red—or its coating; slightly rubbery and pretty good at not transferring physical noise into the earphones. No, it's the length, or lack

of it. A shade under four feet, or slightly more if you use the included four-pole to 2x three-pole adapter, just isn't enough for most desktop PC configurations. It's barely enough to use this headset hooked up to a phone in your pocket.

The listening experience is where the rollercoaster analogy really comes into play, because we hit a ton of high-speed ups, downs, and loop-the-loops with the MasterPulse. First listen is like that terrifying first drop of a steel coaster, particularly with the side plates removed: A massive blast of bass overwhelms your senses. You lurch into the first corner, and put the side plates back on; the bass subsides, but only just. There's not a massive chasm of difference between the two configurations, apart from a slightly more hollow sound with the Bass FX tech deactivated. At first listen, everything is a little muddy; there's no remarkable high point to the sound stage. But then you settle in for the ride, and things aren't quite as terrifying as they first seemed. Long-term listening isn't offensive, it's almost fun. There's a bouncy quality to the plate-clad sound, at least. It's rich enough in bass to suit gaming very well, if not flat enough for audiophile music listeners, and it goes plenty loud without any noticeable distortion.

This is entertaining, then, but not the best ride in the park by any means. Its \$70

MSRP puts it only about 20 bucks away from our perennial headset comparison, the HyperX Cloud II, and that's leagues ahead in terms of features, performance, and long-term enjoyment. If, however, you can get a cut-price ticket—we've seen the MasterPulse listed by major retailers as low as \$29.99—then you're going to have a lot of fun. —ALEX COX



VERDICT

Cooler Master MasterPulse

PULSE Comfortable construction; customizable sound; can be found cut-price.

REPULSE Muddy sound stage; short cable.

\$70, www.coolermaster.com

SPECIFICATIONS

Driver Type	44mm Bass FX
Impedance	50 ohm
Frequency Response	20Hz-20kHz
Design Style	Open/closed back hybrid
Microphone Type	Omni-directional
Connectivity	3.5mm jack
Weight	30.4oz
Cord Length	3.9ft

ID-Cooling Frostflow 240L

Budget... Sort of

FINDING A 240MM dual rad at this price is fairly impressive. There are a few alternatives from the likes of Cooler Master and Thermaltake, both with their own flaws, but the biggest challenge comes from Corsair's Hydro H105 240mm AIO. Coming in at \$104, it's only \$4 more than the Frostflow 240L, and that's a problem for the plucky underdog.

Whether it's the mounting system, the materials, the finish, you name it—the Frostflow falls short in almost every way. But that's to be expected. Corsair is a well-known brand, one that almost single-handedly pioneered AIO liquid-cooling.

The mounting system isn't awful—the fact you can mount it in stages, without needing to balance the two parts together, makes it fairly effective. The problem? The backplate. It's steel, and is padded with a block of foam to prevent shorts upon contact with the mobo. Not a terrible idea, but with support for 1366, 1150/X, and 775 sockets, there's a plethora of holes precut into the foam to allow you to thread your screws through. Except the holes are all a touch too small. Pushing them through begins to tear the foam away from the backplate. The best way to install them is to thread them through the opposite side first, pushing the foam against the backplate, to widen the openings, then

push them back through the correct way. Then it's a case of lining up your backplate with the holes in your mobo, attaching washers on the motherboard side, and securing the backplate with four long threaded nuts acting as stand-offs. After which, thermal paste down, CPU block on, and secure in place with the thumb screws.

But the big problem is appearance. It's hard to get past how cheap the Frostflow looks. The braided cable is nice, the rad a decent quality, but the fans and CPU block seem crafted out of cheap plastic, designed to break upon impact. The texture is just unpleasant, and the LED ring oscillating round in a circle is untameable by any form of desktop control.

That said, it's not all about looks. And where the Frostflow does shine is in its performance. It's a strong contender in the 240mm market, performing as well as any we've seen, even giving our 280mm NZXT Kraken X62 a run for its money. It's not a super-thick radiator, but the included fans do a good job of shifting enough cool

air past the radiator fins to draw excess heat out of the system without causing a ruckus. Our testing suite lets the standard PWM fan profiles included with Asus's Maximus IX Hero manage the fan speed, and it was fairly inaudible even under load.

ID-Cooling's Frostflow is a flawed yet interesting first product from the new kid on the block. It throws punches and includes LED lighting that other competitors don't at this price. Yet it falls flat on overall design, and could do with a touch of refinement when it comes to the AIO mounting procedure. **—ZAK STOREY**

VERDICT

ID-Cooling Frostflow 240L

THERMAL VOID Mounting system better than some; good performance; solid price.

SLURRY Aesthetics need a lot of work; mounting system still flawed.

\$100, www.idcooling.com

BENCHMARKS

	ID-Cooling Frostflow 240L	NZXT Kraken X61
Idle Temperature	25 C	22 C
Prime 95 @ Stock	63 C	57 C
Cinebench @ Stock	51 C	49 C
Far Cry Primal @ Stock	50 C	43 C
Prime 95 @ 4.7GHz	87 C	76 C
Cinebench @ 4.7GHz	77 C	64 C
Far Cry Primal @ 4.7GHz	63 C	51 C

Best scores in bold. Our test bed consists of an Intel Core i7-6700K, AGTX 1080, 16GB of Crucial Ballistix Elite DDR4, and a 500GB Samsung 850 Evo SSD. Each test performed for five minutes, with a 10-minute cooldown.

SPECIFICATIONS

Socket Compatibility	115X, 1366, 2011, 775, AM4, FM2+, AM3+
Radiator Size	240mm
Radiator Thickness	27mm
Cold Plate Material	Copper
Tubing Length	12.4 inches
Radiator Dimensions	10.8 x 4.7 x 1.0 inches
Fan Static Pressure	3.2mmH ₂ O
Fan Airflow	84.5 CFM
Fan Noise	20–38.2 dB(A)
Warranty	Not stated



Asus ROG Gladius II

Completely customizable clicker with a bright upside

SINCE THEY EMERGED from the damp, beige, angular swamp of the early '90s, mice have—at least in comparison to the rest of the PC peripheral market—been objects of scant innovation. Mainly because, really, where is there to go? A thing that fits your hand, some buttons, a wheel, and a sensor that determines how you're moving the thing. Those components are frequently refined, but where's the next big change? What can make the mouse new again? Well, if you're Asus, you'll find at least some of that innovation inspiration both in the current trend of adding RGB LED lighting to absolutely everything, and beneath the chassis of the most pimped-out rides.

So, let's begin with the Gladius II's big shiny selling point, that RGB illumination, an upgrade from the primo Gladius's plain old red wheel and palm light. It's actually quite fun. As much as we'd like to give it a curmudgeonly dismissal, the LEDs—which hook up to Asus's Aura Sync lighting protocol—look brilliant, the underlights projecting a halo on to your mousing surface in whatever color (or colors) you choose, pulsating or breathing if you wish, helping you pick out your mouse in darkened locations, and generally giving you the standard cheap thrill of RGB jollies. That Aura Sync integration means you can, in theory, line up your mouse's lighting with that of the rest of your components—as long as you've bought Asus, of course.

The other step up from Gladius the First is the addition of a thumb-seated resolution button which, if you're running in high DPI mode, drops the res (thus slowing your mouse and increasing your accuracy) for as long as it's depressed. Having this function so close at hand is a bit of a double-edged sword. It's easy to

activate by accident, and for non-gamers, the space might well have been better served by a customizable button, but its position does mean that there's no need to fumble around—it's exactly where you need it in the middle of a virtual firefight. Above the sniper button, there's a pair of additional action buttons, quickly activated by sliding your thumb upward. Waggle your middle finger sufficiently, and you'll find a comfortably notched and rubberized wheel, behind which is a DPI toggle, which jumps between the mouse's two modes. Reasonably standard mouse stuff. The sensor, at 12,000 dpi, is ridiculously sensitive, as are the left and right buttons, at least by default. Included in the package is a pair of stiffer replacement Omron microswitches, easily substituted by unscrewing the mouse's case, pulling out the old ones, and push-fitting the new—the alternatives are perfect for those of us with heavy fingers, and more Omron switches are available online.

PACKAGE DEAL

Innovation being what it is, though, nothing here is actually brand new. Razer's well-regarded DeathAdder Chroma, for example, has underlighting based on its own RGB protocol, while thumb-mounted DPI shifters are reasonably commonplace in gaming mice. Easily replaceable microswitches, at least those that don't require solder, are significantly rarer, but not absolutely unknown. So we need to assess this based on the whole package, rather than any one of its individual features. And, as a whole, the Gladius II is pretty damn awesome.

It's super-comfortable to hold in both palm and claw grips, aided by the

pleasant textured rubberized edges. The combination of silicon pads and rubber bungs on the underside results in a slippery movement feel with satisfying bite. Everything is easy to reach, the locking detachable cable system works well, and despite testing it on a large number of potential mousing surfaces, we were unable to trip up the sensor even slightly. Fantastic.

Is it fantastic enough to justify an \$85 MSRP, though? Well, it's not lefty-compatible, the aforementioned DeathAdder Chroma can be had for a fair chunk less, and you could easily pick up an adequate, though not as luxurious, gaming mouse for \$30, so it depends on what price you put on such indulgence. —ALEX COX

VERDICT
9

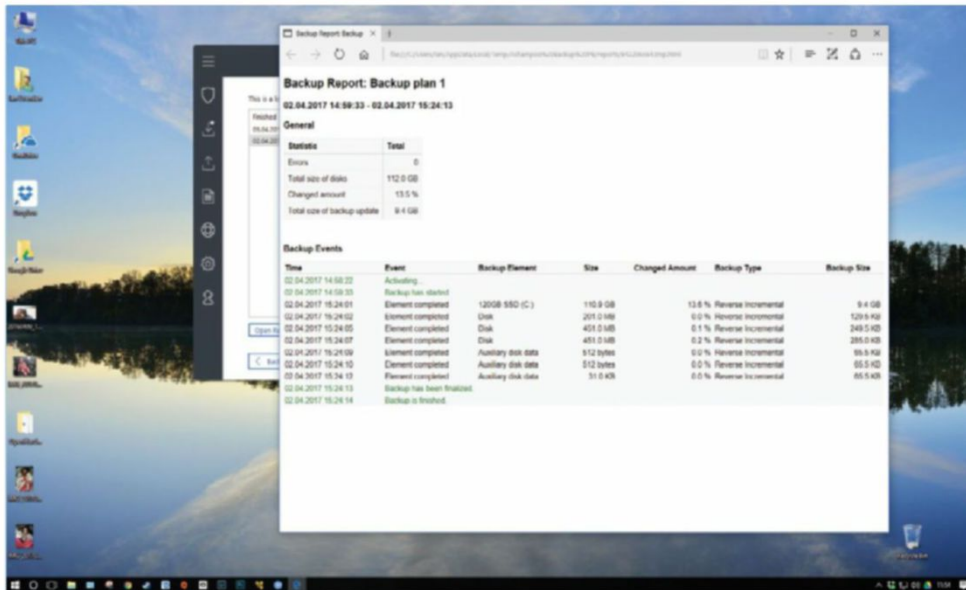
Asus ROG Gladius II
GLADIUS Great feel; awesome lighting; switchable switches.

BADIES Rather expensive; for right-handers only.

\$85, www.asus.com

SPECIFICATIONS

Sensor	Optical
Sensitivity	12,000 dpi
Sensor Model	PixArt PMW3360
Polling Rate	1,000Hz
Programmable Buttons	2
LEDs	RGB wheel, palm, base
Cable Length	6.5ft
Weight	3.9oz



Ashampoo Backup Pro 11

Backup software is boring—until you need it

WINDOWS' BUILT-IN FILE HISTORY is fine, but what PCs need, and it pains us to say this, is something like Apple's Time Machine. An app that grinds away in the background, incrementally backing up your files, and which can be accessed to drop a particular version of a particular file on to your desktop, should you need to recover it.

In these days of cloud storage, you may question the value of a backup app. With all your documents mirrored on Google or Dropbox's servers, why bother backing up to a local disk? Anyone who's had to use System Restore to recover from a ransomware attack, or struggled to find a file that someone else has deleted from a shared folder, will appreciate an easily accessed local repository of your data. Crazy-named German developer Ashampoo thinks it's got a solution with Backup Pro, which can back up entire drives, including hidden and UEFI partitions, to local drives, network locations, or even the cloud. Individual files and folders can be backed up, too, according to a manifest you create.

The latter of these will be of interest for anyone looking for a File History replacement, because it enables you to create a backup that can be explored as a standard Windows directory. Versions of files can be kept for a period of time set by you when you create the backup plan, and zip compression can be added so you don't use titanic amounts of disk space. You'll

still use plenty, though, especially if you're keeping multiple versions of large files backed up several times a day. But there's enough control in the settings to ensure you're not backing up multiple copies of videos that never change.

For a complete backup solution, it makes sense to run both types of backup on a plan that backs up your documents more often than your operating system. This way, should you ever need to restore your system following a freak EMP accident, you'll have a reasonably up-to-date system image, and the most recent copies of your documents.

Backup Pro's interface is particularly straightforward to use. You start by creating a backup plan, choosing what's backed up and where to, how long it's kept, and whether you want a report of any errors emailed to you. The app doesn't stop backing up just because it's encountered an error or thinks there's something wrong with your target drive (we've found File History guilty of this), but instead tells you what went wrong, and what wasn't backed up. This seems a more reliable way of doing things, because most of a backup is better than no backup at all.

If the worst does happen, and you need to rescue your PC, Ashampoo has a comprehensive suite of tools to get you up and running again—although they're only useful if you use them before disaster strikes. You can make a rescue

USB drive or DVD, which invokes the Windows Preinstallation Environment, from where you can restore whole drives, including boot partitions, to a freshly formatted or installed disk. This is a very powerful feature, making it relatively straightforward, if not actually less stressful, to recover an apparently bricked machine. The stress doesn't stop until it's working again.

Compressed backups of our OS and boot partitions, plus all document and image files the app could find across the three SSDs and one hard drive of our test system, with changes kept for 90 days, and the Steam library excluded, used less than 500GB on our external drive. Everybody's usage will be different, as the PC is a wonderfully diverse system, but this brings a full system backup within the reach of cheap external drives. What you need to decide is whether your data is worth the outlay, or whether you're happy to remain with Windows' File History, cloud storage, or free solutions. —IAN EVENDEN



Ashampoo Backup Pro 11

BACKUP Backup plans tailored to you; good compression ratio.

SCREW-UP Can be picky about what you use as a recovery drive.

RECOMMENDED SPECS Windows 7 or later.

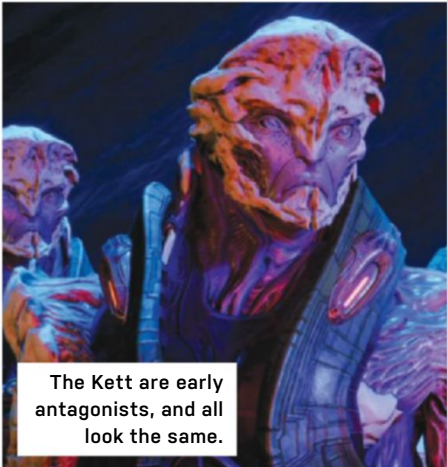
\$50, www.ashampoo.com



Climbing on top of your ship elicits a weary "Really?" from your companion.



This is your dad, and you can inherit his abilities.



The Kett are early antagonists, and all look the same.



The Nexus fulfills the same role as the Citadel in previous games.

Mass Effect Andromeda

Intergalactic lover leads the space invaders

FACIAL ANIMATION GLITCHES are undeniably funny. Also funny is the moment your character suddenly levitates in a tram car while talking to his crewmates, or when an enemy freezes, inviting an assault rifle to the face. *Mass Effect Andromeda* proves to be more than the sum of its bugs, however.

If you've played the other *ME* games, you know what to expect: an RPG you play like a shooter, or maybe the other way round, in space, with mutually pleasurable interspecies mating-port-stimulation a distinct possibility. There's a character creator in which you can make any number of grotesques, and a car in which you can roar around on planetary surfaces, causing trouble. This familiarity isn't necessarily a criticism, though, as it enables you to settle more quickly into a new situation. When that new situation is the same as those that have gone before, well, that would be a criticism.

So, some time during the events of *Mass Effect 2*, humans and the other basically human species of the Milky Way shot five "arks" into space to try to colonize a star cluster in the Andromeda galaxy. Several

centuries later, cryo-stasis, strange energy cloud, something goes wrong, you end up in charge. It's not original, but it's compelling enough. You soon meet some basically human aliens (having digitigrade legs doesn't differ from the humanoid plan enough for our tastes) and, in a move that would see Jean-Luc Picard's palm twitch toward his brow ridge, shoot them dead.

With your new ship, the *Tempest*, plus a crew made up of TV talent show contestants and Priss from *Blade Runner*, you journey around the worlds earmarked for colonization, solving ancient sudoku puzzles, and achieving objectives to increase crew loyalty or raise the viability of your colonies. You roar across their surfaces in your space buggy, and shoot lots of bad guys. There's also all the planet-scanning and resource-mining we loved from the previous games. On top of that, you can uncover the true purpose of your journey between galaxies, and discover the history of the planets you're exploring.

There's a lot going on, and the game does well to keep the pace going, controlling the

drip of information well. Your ability to choose the order of the planets you visit in this new, slightly more open, galaxy means the similarities to *Mass Effect 1* and *Dragon Age Inquisition* (in both structure and the way you carve a space-empire from the smoking corpses of aliens) is less obvious.

The best bits of *Andromeda* remind us how good *Mass Effect* can be. The rest provides a solid base for the inevitable trilogy to build on. It's well crafted, despite bugs that will surely be patched out, and shows that a franchise reboot doesn't have to be a complete overhaul. **-IAN EVENDEN**

VERDICT
8

Mass Effect Andromeda

■ **NGC 224** Sprawling plot; great visuals; top-quality voice acting.

■ **NGC 4548** A few bugs; long initial load times; quality is variable.

🔧 **RECOMMENDED SPECS** Intel Core i7-4790 or AMD FX-8350; 16GB; GTX 1060 3GB or RX 480 4GB.

\$70, <http://masseffect.com>, ESRB: M



Dead Rising 4

That is not dead which can eternal combo

DEAD RISING GAMES have never been subtle, and *DR4* is a riot of button-mashing combat, bizarre weapons, and more targets than you could ever take down. Pushing a large number of character models on screen at once, previous games have brought frame rates crashing down.

No such problems with *Dead Rising 4*—we raised the game's initially conservative graphics settings for our GTX 970 to Very High without dropping much below 60fps. But it's not the most refined-looking game out there, with very boxy environmental details, and a restrained color palette.

It's not refined in play, either, as photojournalist Frank West, returning from the first game, mulches his way through the undead. Also returning is the shopping mall setting, used in *Dawn of the Dead* as a sharp satire on consumerism, though Capcom blunts the point by having the zombie outbreak occur on Black Friday. What haven't returned are the earlier games' timers, which piled on the pressure. *DR4*'s zombie-slaying is more relaxed, with only the health bars of your allies reminding you

of what you're meant to be doing. There's also a modern checkpoint and save system, consigning the save rooms of earlier games to a deserted graveyard somewhere, and Frank can craft new weapons anywhere, without having to find a workbench.

This is all to the good, as *DR4* offers a bewildering number of combo weapons, constructed from blueprints and seeing grenades strapped to sledgehammers, fireworks connected to crossbows, and various uses for electric prods and liquid nitrogen. Weapons degrade with use, but are so plentiful you keep your inventory full, and switch them out as you please. Guns are less satisfying than huge sweeps of a melee weapon, and are better used for lone targets than zombie crowd control. Killing zombies racks up a kill counter, and opens up special moves to kill even more. Just crossing the floor can see you smash over 100 with a guitar, baseball bat, or chair, while picking up something like a lawnmower sees even more crumple.

Black Friday is, of course, right before Christmas, and jaunty holiday-season

music is everywhere. It's the perfect ironic soundtrack to the slaughter. The zombie horde is mixed up by other enemies, military operatives, and "maniacs"—including a giant turkey—but once dealt with, it's back into the sea of human flesh once again.

Maybe that's *Dead Rising 4*'s downfall. You're dropped into the mall early on, and—even though it's not a long game, and there are other locations—hacking your way through animated corpses, soldiers, and giggling maniacs becomes a bit samey. Once you've seen all the moves, built the weapons, and taken the photos, what more is there for Frank to do? —IAN EVENEDEN

VERDICT 	Dead Rising 4
	ROMERO Lots of fun, blood, and weapons.
	ANDERSON Primitive looks and gameplay.
RECOMMENDED SPECS Intel i7-3770 or AMD FX 8350; 8GB; GeForce GTX 970 or AMD Radeon R9 290.	
\$60, http://deadrising.com , ESRB: M	

LAB NOTES

ZAK STOREY, REVIEWS EDITOR



Motherboard Hell

Nothing is easy when everything is new

DON'T GET ME WRONG, I have a cushy job—I'm fully aware of that. But that doesn't detract from the fact that motherboard group tests are some of the most infuriating roundups you can ever work on. Soul destroying.

Take Z170, for example. You pick five to ten motherboards, and choose a whole suite of benchmarks to check performance across multiple factors: rendering, gaming, storage support, overclocking. The thing is, you're not looking for variance, but for them all to be identical. Reason being, a good motherboard shouldn't affect performance outside of overclocking. If it does, something's going wrong somewhere, and you can bet your last dollar that power draw, clock speeds, or any number of other factors will be far higher than they should be.

Take Ryzen, on the other hand, and you're welcomed into a whole new world of

hurt. New architectures and chip designs are fraught with problems. Realistically speaking, Intel's Core architecture design is coming up to 11 years old. It may receive tweaks here and there, added I/O support, and drops in transistor size, but that's about it. In short, it has essentially been the same design layout since the days of Sandy Bridge. If you compare Ryzen to Piledriver, however, it's entirely different. A completely new design from the ground up. And because of that, it's loaded with problems, particularly on the BIOS front, as AIB partners race to release a new and improved BIOSes with better support for memory, and general overclocking stability for a chip that isn't just a rehash of a design that's been gradually refined for the last 11 years.

To cut a long story short, I killed two motherboards via BIOS updates, another



A Ryzen 7 1800X sitting snugly in an Asus Crosshair VI Hero.

was dead on arrival, and I managed to nuke one of our Ryzen 1800X samples in the process of this group test. To say it was hell would be an understatement.



BO MOORE
Technology Editor

It's time for the Windows Store to get an overhaul. I had hoped that the Creators Update would give the often-overlooked digital storefront some love, but it received no such attention this go-around. Instead, we have the same old busted UI, glitchy performance, and conglomeration of offerings. Why would I ever want to use it? Even after

applying filters to try to find something worth playing, the games storefront puts options such as *Resident Evil* and *Forza Horizon* alongside the likes of *Bejeweled*, *Wheel of Fortune*, and a pile of garbage kids' apps. You'd think that the "Creators Update" would offer an effective place for creators to sell their creations, but here we are. Better luck next time.



TUAN NGUYEN
Editor-in-Chief

What's it like to have 2Gb/s enterprise fiber Internet service from Comcast? You get dedicated IP addresses and dedicated uncapped bandwidth—no restrictions. What's even crazier is that Comcast throws in a spare 1Gb/s line just in case. But it wasn't until I had an issue that the value of having dedicated 24/7 service showed its

worth. I was up late playing *Diablo 3*, and started having random lag and disconnects. It was affecting all my machines. Rebooting network equipment didn't help, so I called my dedicated Comcast number to explain my issue. Comcast immediately sent out a senior fiber tech to my place to address the issue. Incredible. Incredibly spoiled is what I am.

Editors' Picks: Digital Discoveries

Jarred Walton, senior editor, and Alan Dexter, executive editor, are pumped about the latest tech



RYZEN 5 1600

AMD just finished rolling out its Ryzen 7 and Ryzen 5 CPUs, and do you know which is my favorite? Not the 1800X

or even the 1700, though the 1700 does come in second. No, the best of the current crop of seven Ryzen CPUs is the 1600. Stock clocks are pretty tame at only 3.2–3.6GHz, but like all Ryzens, it's fully multiplier unlocked, so you can overclock to the same 3.9–4.0GHz that you'll hit with higher priced Ryzen chips.

It's not just about overclocking, though. I do like the eight-core Ryzen 7 chips, but they're in the high-end market, with the least expensive starting at \$330. At just \$220, the 1600 makes six-core/12-thread computing truly affordable. And you're not restricted to more expensive "enthusiast" motherboards. Pair this puppy up with a B350 mobo and some decent DDR4-3200 memory, and you're looking at similar performance to Intel's six-core i7-5820K/6800K at about half the cost.

Just don't get stuck in the rut of chasing the final 100MHz of overclocking performance. That usually requires substantially more voltage, which means more heat. Even at 3.9GHz, the Ryzen 5 1600 is super-capable, and will smoke any similarly priced Core i5 when it comes to CPU-intensive workloads. \$219, www.amd.com



GAME MODE BROADCASTING

We've covered game streaming plenty of times, with tutorials for the likes of OBS and

XSplite for more serious streaming, while Nvidia's ShadowPlay takes on AMD Gaming Evolved for specific graphics card options. These have now been supplemented by the Windows 10 Creators Update, which throws integrated game streaming into the mix.

With the latest version of Windows 10, broadcasting is as easy as hitting Win-G and clicking the broadcast button (or just hitting Win-Alt-B). You can turn on your webcam and record from your mic as well, but the basic idea is that you can be streaming in a matter of seconds. There is a caveat, though: Windows 10's Game Mode streams to Beam, the streaming service Microsoft bought in the fall of last year. It offers low latency streaming (200ms) and includes interactive elements, if you want to set them up.

Beam's problem is Twitch, which owns streaming. It's the go-to site, and it's built a community that Beam can only dream of. To give you an idea of the uphill struggle Microsoft has to overcome, right now, the top stream on Beam has around 200 viewers, while Twitch's most popular *Dota 2* stream has 100,000. That's quite a hill.

\$Free, www.beam.pro



Panasonic Wings RP-BTS30

I FINALLY CAVED, and invested in a pair of Bluetooth headphones for my training. My Galaxy S7 Edge has taken numerous beatings over the last year. It was with me when I had the biggest crash of my life, in the pouring rain, effectively saving my life in one gnarly mountain bike accident. It's operated through dirt, grit, and grime, in and out of rugged cases. But, alas, the headphone jack has sighed its last. And, annoyingly, mostly due to my own error—I took a toothpick, and tried to scrape out the fluff that had accumulated inside. When I plugged my headphones back in, it was dead.

I can't train without music (yes, I'm one of those antisocial types), so I had no choice but to invest in something I've scorned ever since Apple announced it was dropping the headphone jack.

So, what can I say about the Panasonic Wings RP-BTS30? They're actually pretty good. Once you get them to sit right, the moldable ear lock can be shaped to fit any ear, they lock securely into place, and the onside buttons are quite effective when you get used to them. Audio quality is, well, acceptable—but when you're exerting all that physical energy, audio quality isn't top of your agenda.

As far as battery life goes, you can expect six to seven hours at full volume, which is modestly loud—not particularly ear-damaging, but not inaudible either. Battery is the biggy, though, and having these go dead on you, midway through a training session, is simply depressing. These are a solid pair of affordable Bluetooth headphones, but if charging these mini cans every day is too onerous, you might be better off investing in a pair of analogs instead. **—ZS**

\$80, www.panasonic.com

LETTERS

WE TACKLE TOUGH READER QUESTIONS ON...

- > Overclocking Mastery
- > Router Recommendations
- > Ergonomic Keyboards

Master Overclocking

I recently built a new gaming PC. It's been 15 years or so since I last built one, and I'd say I did quite well. I've been running "custom specced" gaming laptops for several years due to their portability and ease of use. My new build is an Intel Core i7-7700k, Asus TUF Z270 Mark 1, G.Skill Trident Z 3600 32GB, Samsung 850 Evo 1TB SSD, Seagate Barracuda 4TB SATA 6GB, EVGA FTW 1080 GTX, Corsair H100vi, EVGA Supernova 1,200W P2 PSU, and Acer xb1 27hu.

This was my dream machine, and I finally saved enough money to build it. It has been up and running for a month or two, and I have an assortment of the latest games on it. My question lies in overclocking—I guess I'm not getting it, so to speak. I've read a ton of forums and seen tons of videos. At first, it didn't seem like my graphics card even "turned on." Games were very glitchy, and frame rates sucked. I've never been an overclocker, so I'm a noob.

I use EVGA OCX software for my GPU, and stock Asus BIOS for CPU overclocks. When booting, OC is set to automatic for performance

through mobo, and it says I'm overclocked 9 percent. On my EVGA OCX, I simply run at 120 percent power target, and 92 C temp target, and that seemed to "turn on" my GPU. I get good FPS, but it feels like I'm missing out. Heaven crashes if I adjust the GPU clock offset 25-125, which people say my card should easily achieve.

I have not messed with power in any way. I am afraid of ruining what I worked on forever to build. I'm just looking for OC advice, so I can get the most out of my dream machine. I know how to watch temps, and have an idea how Heaven works, but I feel like my system is capable of so much more, and I just don't know how or what to tweak to unlock its true power. Or maybe my rig isn't as powerful as I thought. Any help would be appreciated. **—Ryan Havens**

REVIEWS EDITOR ZAK

STOREY RESPONDS: Sounds like you've got quite the conundrum occurring with your GTX 1080 there. That's one mightily impressive system, to say the least. You certainly shouldn't be seeing any frame rate issues at 1440p with that

setup, even on the latest AAA titles.

I have to apologize in advance, but there's a few things we need to get clear before we start. Firstly, how hot is your CPU running after an hour or two of idling on desktop? I suggest using HWMonitor to check this. It's possible the cooler might not be mounted correctly, and the CPU is overheating and bottlenecking your GPU. Also, are you definitely running the DisplayPort cable from the monitor into the back of the graphics card, and not the motherboard? I know it sounds obvious, but we just have to double-check.

Next up, I'd suggest downloading the basic version of 3DMark Fire Strike, and running the standard Fire Strike benchmark at stock settings (with no overclocking profiles applied in EVGA OCX), and seeing what score you get. Ideally, what we're looking for, with a base GTX 1080, is a score higher than 17,000 or so.

Also, could you go into a little more detail about these glitches you're seeing? During overclocking, it's common

to see the screen flicker, or particular textures flicker, when the GPU is clocked too high, becoming unstable. This can look like all sorts—basically, something out of the norm; the colors purple and pink, in particular, turn up a lot in quick flashes, too.

If I were to hazard a guess, I'd say it's possible you've been particularly unlucky in the Silicon Lottery with your GPU. And that it may already be at its very limits when it comes to core overlocks, after you set the overclock profile. We've had cards in the past that fail to run at their stated overclock profile. An Asus Strix GTX 1080, in particular, had continual bugs, and crashed when we ran our benchmarking suite at its "OC" profile in GPU Tweak. It's possible you may be in the same position.

If we can deduce that this is the case, then it's potentially worth getting in touch with EVGA, and seeing if you can RMA your card, as it's not operating at its advertised frequencies. Alternatively, you could run the card at stock, without the overclock profile, or even underclock it a touch to improve stability.

↘ submit your questions to: comments@maximumpc.com

A Route to Love

You've had many features on cases, but regrettably few on routers. The last I can remember was a feature on budget routers in October 2014. I'm in the market for a new and more capable 802.11ac router. Our router is the centerpiece of our home network, often with as many as 16 devices (phones, tablets, and PC) connected. While routers don't have as much marketing zing as GPUs and CPUs (or cases), they deserve a little love too.

—Cliff Steer

EXECUTIVE EDITOR ALAN

DEXTER RESPONDS: Routers are still an essential piece of our connected lives, but things have calmed down a lot recently, which is why we haven't looked at them in a while. They are on our "big list of things to cover," though, and your letter means that such coverage has just shuffled a little closer to seeing the light of day. In the meantime, here are Tuan's thoughts:

It all depends on what you're looking for in your new "more capable" router. For the best range, the TP-Link Archer C7 (v2) is your best bet. It has incredible range performance, and is priced very competitively. Depending on your home size, you may also want to consider mesh routers, which blanket your entire dwelling in sweet radio waves. But mesh routers tend to lack power-user features. For the ultimate in features, you might want to check out Netgear's X10 Nighthawk. It's a cutting-edge 802.11ad router that'll knock the pants off your old model. The only caveat is that it's \$400.

Carpal Diem

The List recently featured the seven best keyboards. How come none are ergonomic? How come you never test ergo keyboards? As a gamer, they're a godsend. —Chris Ajemian

[NOW ONLINE]

PROTECT YOUR PRIVACY AND PC ONLINE



Keeping your data to yourself on the Internet is hard, and it's getting tougher every day. With the recent decision by Congress to let Internet service providers continue to run wild with your browsing data without you knowing, a lot of people are pissed (and the ones who aren't probably should be). While it's true that a lot of us give up data in exchange for services (think Google, Facebook, and other applications), an ISP is different. Without an ISP, you can't get online at all. Your wireless provider, cable company, or copper-wire telco generally set prices in a vacuum, and are the first gatekeepers between you and your Steam account. Read the full story online: <http://bit.ly/2pcMAoA>

EXECUTIVE EDITOR ALAN

DEXTER RESPONDS:

Ergonomic keyboards were all the rage a few years back, and even this jaded old hack briefly jumped on the bandwagon to see what all the fuss was about—I'll freely admit that I have a soft spot for the pale Microsoft Ergonomic keyboard that I used for a few years, despite it taking up a ludicrous amount of desk space. The problem is, the actual benefits of the slightly more relaxed hand position are hard to prove, and keyboard manufacturers saw demands for such devices dwindle, forcing them to be little more than niche genre. If you're definitely sold on them, though, we see that there are plenty of options available on the likes of Newegg, so we suggest you just grab a more recent model from a manufacturer that you trust (Microsoft gets the nod from us on this front). As a final note, we do intend to look at ergonomics

in the future, and keyboards will make an appearance as part of that.

Buyer's Remorse

Jeremy Laird's article regarding Intel Optane (April issue) was interesting to say the least, but I have a feeling Intel's speed claims are wildly overstated, and AMD is certainly in no danger after its release of Ryzen. Time will tell regarding Optane, but I'm currently in the market for a processor and graphics card upgrade. For the first time since 2006, I'm looking AMD's way after reading several Internet reviews and finally receiving yours of Ryzen. The price to performance ratio is nothing short of amazing, from what I am reading, and Intel has me a bit disgruntled when my last upgrade (Sandy Bridge to Haswell) produced but a "tick" of performance increase. I had buyer's remorse for months. Love the magazine, and thank you for the hard work.

—Ryan Anthony

EXECUTIVE EDITOR ALAN

DEXTER RESPONDS: We'll have a few more updates on Optane through the year, and while you may be right as far as the final performance is concerned, we're cautiously optimistic about what it could deliver. As for Ryzen, we have certainly been impressed by the performance it offers, and at a great price, too, although those early teething problems have us being a little cautious at the same time.

Making Viruses

First, I really like *Maximum PC*. Your staff of experts keep me close to the pointy end of the stick when it comes to the latest news in the computing field. I do have a question, which is: Who is creating all these viruses that we have to cope with, and what is their motivation? This has been going on for years, and I am just curious. —Ray Dovel

EXECUTIVE EDITOR ALAN

DEXTER RESPONDS: It may amaze you to discover, but there are actual virus kits available these days that mean that anyone who wants to can create a virus fairly easily. So the "who" is probably less important than the "why." Unfortunately, apart from being a mental exercise in circumventing various protection systems, the reasons for creating malicious code aren't obvious either. Slightly more straightforward is the current fad in creating ransomware, which at least has a motive with a more basic end goal—extracting money from people's infected machines. We're not condoning such activities, obviously, just trying to understand who does this, and why. But yes, the whole idea behind viruses isn't exactly straightforward, other than some people just want to watch the world burn. ☹

We've upgraded

NEW
SITE LIVE
NOW



- ✓ Designed to suit every screen
- ✓ Complete round-the-clock news
- ✓ The best PC reviews and features
- ✓ In-depth hardware coverage

PC GAMER.COM THE GLOBAL AUTHORITY ON PC GAMES

TAKE IT FROM A GEEK.™

THE BUILDS

BUDGET



MID-RANGE



INGREDIENTS

PART		PRICE
Case	Phanteks Enthoo Evolv ITX	\$70
PSU	EVGA 450B Bronze	\$40
Mobo	MSI B250I PRO Mini ITX	\$90
CPU	Intel Pentium G4600	\$90
GPU	Gigabyte GeForce GTX 1060 Mini ITX OC 3GB NEW	\$190
RAM	8GB (2x 4GB) Patriot Viper Elite DDR4 2400	\$58
SSD	SanDisk Z410 240GB SATA 2.5-inch NEW	\$85
HDD	1TB Western Digital RE3 7,200rpm NEW	\$54
OS	Ubuntu Desktop Linux 16.04 LTS 64-bit	\$16

Approximate Price: \$693

THERE AREN'T MANY CHANGES to the budget system this month—although, given we're happy with the base of the Pentium G4600, that's no bad thing. There are no price shifts on the CPU, motherboard, or graphics card front, although this hasn't stopped us changing one of those items: The Gigabyte GTX 1060 Mini ITX OC 3GB boasts a higher core clock speed over the EVGA we used in last month's build, all for the same cash. The Gigabyte card runs the core at 1,556MHz in OC Mode, boosting up to 1,771MHz, which equates to slightly smoother performance. The other changes are on the storage front, as we saw SSD prices shuffle upward again, so back to the SanDisk Z410 once more. To offset its price increase slightly, we swapped to a Western Digital hard drive, which helped bring the price in slightly cheaper than last month. It's worth noting that Ubuntu 17.04 is now available, although we'd recommend sticking with the LTS for now.

INGREDIENTS

PART		PRICE
Case	NZXT S340 Elite	\$100
PSU	EVGA SuperNOVA 550 GS Gold	\$85
Mobo	MSI Z270 SLI Pro Series	\$140
CPU	Intel Core i5-7600K	\$240
Cooler	Corsair H100i v2	\$120
GPU	Zotac GeForce GTX 1070	\$370
RAM	16GB (2x 8GB) G.Skill V Series DDR4-2400	\$102
SSD	256GB Intel SSD 600p M.2 PCIe	\$100
HDD	Western Digital Blue Series 1TB 7,200rpm	\$50
OS	Windows 10 Home 64-bit OEM	\$100

Approximate Price: \$1,407

WE HAVEN'T CHANGED a single component in our mainstream build. This is mainly because pricing across the board has been stable (and that tends to be the driving factor for change), but also because we're eyeing up switching the mainstream system over to Ryzen soon. We're not quite ready to pull the trigger just yet, as we want to take a longer look at the other Ryzen 5 chips, but all being well, you can expect changes shortly. For now, though, this system still demands respect: It's a powerful mid-range system that looks great, has plenty of raw performance, and offers space for upgrades. We saw the price of the Zotac graphics card drop by \$10, but this was eaten up by an increase for the Intel M.2 drive. Elsewhere, we saw a \$5 increase on the power supply pricing, while the RAM dropped in price. Admittedly only by a single dollar, but it still gives us hope that we've weathered the RAM pricing storm, and that cheaper memory for all is the result.



WE'VE MANAGED TO SQUEEZE the price of our Turbo build under \$3,000 this issue, shaving off over \$100 without affecting its power or functionality. There's a couple of reasons for that, but the switch to the MSI X370 Gaming Pro Carbon is fundamental, because it's \$75 cheaper than the Asus Crosshair VI Hero that we've been recommending until now. The outgoing board is still a great option, but MSI's Pro Carbon gets the nod this issue as it has a great feature set, performs well, and manages to back that up with great value for money. There's a reason it took home the trophy from this month's AM4 roundup.

Motherboard aside, we also saw a couple of price drops to help things along. The \$30 drop on the top-end Ryzen 7 1800X was unexpected, but welcome. The HyperX RAM was the other component to see a price drop—again, hopefully signaling an end to the price hikes we've seen recently. It's worth keeping an eye out for bundles when picking up your motherboard and processor, as you can often save a few bucks on the components you were going to buy anyway—bundles with graphics cards and/or RAM are the most common, although just the CPU and motherboard on their own can save a bit of cash, too.

The last thing we changed was the data drive, as the 5TB Black wasn't available this time around, so we've gone with the slightly cheaper 4TB model instead—it's still plenty of local storage, and if you need more, you should probably be looking at a NAS anyway.

For more of our component recommendations, visit www.maximumpc.com/best-of-the-best

INGREDIENTS

PART		PRICE
Case	Phanteks Eclipse P400S Tempered Glass Silent Edition	\$90
PSU	Corsair RM850X Modular Gold	\$120
Mobo	MSI X370 Gaming Pro Carbon NEW	\$180
CPU	AMD Ryzen 7 1800X	\$470
Cooler	NZXT Kraken X62 280mm AIO	\$160
GPU	EVGA GeForce GTX 1080 Ti	\$700
RAM	32GB [2x 16GB] HyperX Savage DDR4-2666	\$278
SSD	1TB Samsung 960 Pro M.2 NVMe SSD	\$630
HDD	4TB WD Black 7,200rpm NEW	\$208
OS	Windows 10 Home 64-bit OEM	\$100

Approximate Price: \$2,936

UPGRADE OF THE MONTH



NVIDIA GEFORCE GTX 1060 3GB

Whenever a new graphics card comes out, we retest our suite of cards with the latest drivers to see how everything lines up, and it's at times like this that we can reassess an otherwise known entity. That's exactly what has happened with the release of the RX 580—it's made us look at the 3GB spin of the GTX 1060 in a new light, and it's a light that makes this aging card shine. For less than \$200, you get a card that can handle 1080p gaming at 60fps at the highest settings. Unless you've got a higher-resolution screen, there's no reason to go for anything higher.

\$190, www.nvidia.com

Maximum PC (ISSN 1522-4279) is published 13 times a year, monthly plus Holiday issue following December issue, by Future US, Inc., One Lombard Street, Suite 200, San Francisco, CA 94111. Phone: (650) 872-1642. Fax: (650) 872-2207. Website: www.futureus.com. Periodicals postage paid in San Bruno, CA, and at additional mailing offices. Newsstand distribution is handled by Curtis Circulation Company. Basic subscription rates: one year (13 issues) US: \$24; Canada: US\$40; Foreign: US\$40. Canadian and

foreign orders must be prepaid. Canadian price includes postage and GST (GST #R128220688). PMA #40612608. Subscriptions do not include newsstand specials. POSTMASTER: Send changes of address to Maximum PC, PO Box 5852, Harlan, IA 51593-1352. Standard Mail enclosure in the following editions: None. Ride-Along enclosure in the following editions: None. Returns: IMEX Global Solutions, PO Box 25542, London, ON N6C 6B2, Canada. Future US, Inc. also publishes @Gamer, MacLife,

The Official Xbox Magazine, and PC Gamer. Entire contents copyright 2017, Future US, Inc. All rights reserved. Reproduction in whole or in part is prohibited. Future US, Inc. is not affiliated with the companies or products covered in Maximum PC. Reproduction on the Internet of the articles and pictures in this magazine is illegal without the prior written consent of Maximum PC. Products named in the pages of Maximum PC are trademarks of their respective companies. PRODUCED IN THE UNITED STATES OF AMERICA.



ALIENWARE™



17



ENGINEERED
TO WREAK
HAVOC.

The new Alienware 17 is ready for VR, features innovative Tobii eye tracking, boasts a new premium industrial design and has been upgraded with the latest NVIDIA 10-series graphics for a gaming experience so visceral and real, you'll have to decide how deep you're willing to go. We're Game.

START GAMING AT ALIENWARE.COM

Alienware is a trademark of Dell Inc. Intel, the Intel Logo, Intel Inside, Intel Core, and Core Inside are trademarks of the Intel Corporation in the U.S. and/or other countries.

Intel Inside®.
Extraordinary
Performance
Outside.





WORLD'S MOST ADVANCED PCs

Designed with a passion for performance, Digital Storm PCs are expertly built with unmatched engineering and craftsmanship.



LEARN MORE: WWW.DIGITALSTORM.COM

Digital Storm PCs featuring Intel® Core™ i7 processors.

